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GAMING MODELS FOR MILITARY OPERATIONS IN BUILT-UP AREAS

KFR 93-76

Final Technical Report

November 1976

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ABSTRACT

This volume is the Final Technical Report: Gaming Models for Military Operations in Built-Up Areas (MOBA). It describes the results of research performed under contract DAAH01-74-C-0710. Those results include the design, development and exercise of a gaming structure comprising two distinct levels of gaming. Both levels of gaming employ a player directed simulation called Military Operations in Built-Up Areas Combat Simulation (MOBACS). The results reported in this volume are supported by four additional volumes of user documentation.

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SUMMARY

This report constitutes the final technical report of the research program entitled Gaming Models for Military Operations in Built-up Areas (MOBA). The content of this report comprises three principal sections. An introductory section gives information on the research program itself, which began as a DARPA sponsored program, and in the latter stages included participation by the U.S. Army Training and Doctrine Command (TRADOC). The second and third sections of this report give a summary description of the resultant design in terms of both methodology and simulation structure. The third section reports on the exercise and extended development of the Gaming Models for MOBA.

This final technical report summarizes information from and is supported by four volumes of user documentation:

Volume 1. Methodology. This volume describes the analytic methodology and simulation methodology used in the design and development.

Volume 2. Terrain Data Model, European Site 1. This volume contains a technical description of the terrain model, and gives a data listing for a TRADOC defined terrain site.

Volume 3. MOBACS * User's Guide. This volume gives user oriented guidelines for the simulation imbedded in the games.

Volume 4. MOBACS Programmer's Guide. This volume gives information oriented toward the programmer/program operator of MOBACS.

The research program to develop Gaming Models for MOBA was undertaken in response to an emerging need for means to evaluate the utility of operational concepts, materiel systems, and employment of forces in the built-up area characteristic of the Western European area.

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* Military Operations in Built-Up Areas Combat Simulation

The resulting game design is intended to permit maximum flexibility of use in research applications, and to provide the basis for a systematic, recursive investigation of research problems. The primary method of achieving this capability is the provision of two distinct game modes of operation: the Force Operations Level Game and the Unit Operations Level Game. The Force Operations Level Game provides for simulation of approximately a Brigade size force at about platoon level resolution. The game is fully team interactive and operates in the cyclic mode (repetitive short combat periods) with players inputting orders at the beginning of each period. The Unit Operations Level Game provides for simulation of approximately company level operations with squad or fire team level resolution.

Specific analyses capabilities are based comparative concept analysis at the force operations level with the identification of critical unit sequences of action within the force operations. These critical unit action sequences are subjected to detailed analysis in closed game simulation (Unit Operations Level Game) which permits automatic replay of the situation with varied input parameter values on each replay. This latter technique permits the analysis of the sensitivity of outcome to various assumptions of input value.

The intended research applications of the Gaming Model for MOBA are:

- Comparative evaluation of force structure and force mix concepts, particularly as applied to combat task force organization.
- Comparative evaluation of alternate doctrinal and tactical concepts.
- Evaluation of weapon system and weapon mix concepts.

Research applications include both conventional and built-up area operations for infantry, armor, mechanized, air mobile, and support fire elements.

Exercise and extended development of the design was undertaken with the purpose of demonstrating the operability of the gaming models and for the purpose of validation aimed at discovering and correcting weaknesses. Exercise and

extended development followed two basic paths. First, trials of basic design structures and techniques were conducted at various points throughout the program for the purpose of verifying methodology. Second, operational trials of the developed design were conducted.

The trials of basic design structures included: (1) demonstration of a Test-bed Game used as an interim vehicle for trying methodologies; (2) conduct of an extended map exercise to generate a plausible MOBA scenario; and, (3) early, initial system trials of the simulation structure.

Operational trials included full system testing using a subset - a "slice" - of the MOBA scenario adapted for simulation input. The testing called for verification of proper system processing of inputs, reproduction of realistic combat results, and production of player outputs.

Operational trials also included component testing to establish the accuracy and behavioral characteristics of elements of the physical modeling.

I. INTRODUCTION

A. GENERAL

This main report volume, supported by additional volumes of detailed documentation, describes the research performed under Contract DAAH01-74-C-0710, and amendments thereto. The research program was sponsored by the Defense Research Projects Agency.

The purpose of the research program was to develop the research tools necessary for the systematic evaluation of advanced materiel and operational concepts integrated into force structures tailored for military operations in built-up areas (MOBA).

The complete documentation of this research effort is contained in five volumes as follows:

- Volume 0: Final Technical Report. This volume summarizes the principal activities of the research program, Gaming Models for MOBA. Significant elements of the conduct of the study are discussed. Summary descriptions of study results are given, including methodology development, MOBACS simulation development, supporting research and exercise and evaluation.

- Volume 1: Methodology. This volume describes the analytic methodology and simulation methodology used in the design and development of the Gaming Models for MOBA. The report of analytic methodology stresses the techniques developed for the unique characteristics of the built up environment. The report of simulation methodology provides a description of the interrelation of various simulation modules, and optional modes of operation.

- Volume 2: Terrain Data Model, European Site 1. This volume gives a technical description of the terrain data model developed for Gaming Models for MOBA, a description of base data preparation (an interim research data model), and the data sampling and reduction techniques employed. A complete formatted listing of terrain data is given.

- Volume 3: MOBACS User's Manual. This volume provides user information for the Military Operations in Built-Up Areas Combat Simulation (MOBACS).

The first portion of this volume provides an operational description of the simulation, while the second portion of the volume provides detailed guides and format description of all input data forms.

- Volume 4: MOBACS Programmer's Guide. This volume gives information specifically oriented toward the programmer/program operator of MOBACS. The volume provides a detailed description of the program logic, variables and subroutine usage, and a complete program listing.

This volume constitutes the fiscal technical report of the research program entitled Gaming Models for Military Operations in Build-Up Areas (MOBA). The contents of this volume are organized into three principal sections with two appendices. The introductory section gives information on the research program itself. The second and third sections report program results in developing Gaming Models for MOBA. In the second section, a description of the resultant design and development is given in terms of the design methodology and the computer programs structure. The third section reports of the exercise and extended development of the Gaming Models for MOBA. Two MOBA scenario developments undertaken as part of the exercise and extended development appear as Appendix A and Appendix B. The material appearing in this volume constitutes a summary of technical results culled from various volumes of the user documentation.

B. RESEARCH STUDY

1. Background

The research program to develop Gaming Models for Military Operations in Built-Up Areas was undertaken in response to an emerging need for means to evaluate the utility of material systems and concepts of employment of forces for military operations in built-up areas overseas, particularly the Western Europe area. While acceptable analytic means had been developed previously for the assessment of individual weapons and other equipment, a critical gap was identified in our capability to envision their interrelationships and to evaluate their augmentation of combat unit effectiveness in the uniquely constrained built-up environment. A particular need was identified to integrate - in an evaluative sense - the operations of infantry, armor, artillery and other support systems into task organized force options so that comparative mission effectiveness could be estimated in a systematic way.

It was recognized that in recent years the U.S. military doctrine and materiel, especially for ground combat, remained largely based on the rural field environment. Yet, examination of the Western European area showed increasing potential frequency, complexity, and criticality of combat in built-up areas. Demographic, political and military studies clearly emphasized this trend toward city fighting for future military operations. For example, a U.K. study concluded that built-up regions will be unavoidable and crucial in the event of a conventional conflict in Europe. The Office of the Secretary of Defense also recognized this trend and the potential makeshift nature of the adaptation of field material and tactics to the urban environment.

In 1970 IDA performed a study on the subject of "Promising Areas of Research and Development for Tactical Operations in an Overseas Urban Environment." In 1971 OSD convened a panel to follow-up on the IDA study and this led, in 1972, to the ARPA-sponsored study of Military Operations in Built-Up Areas (MOBA). In addition to the study project coordination role, the remaining substantive portions of the study were divided into military functional categories as follows:

1) Firepower by Ketron, Inc.
2) Mobility by Calspan Corp.,
3) Surveillance by GTE Sylvania
4) Communications by GTE Sylvania and
5) Civil Interaction by Battelle Columbus Laboratories.

During the study, these contractors analyzed the posture of U.S. forces to conduct military operations in built-up regions overseas and identified numerous areas in which our capabilities might be improved for this operational context. These studies included examination of past combat, assessment of current force structure and doctrine, evaluation of standard and developmental materiel systems, and critical appraisals of our performance capabilities in the context of selected conditions of engagement in urban environments.

The findings of this work included identified shortcomings in our doctrine, training, organization, testing, and materiel acquisition practices with respect to urban operations. The specifics of these findings in terms of both available and required system performance characteristics and in terms of threat descriptions and combat engagement conditions provided a valuable basis for this research effort.

2. Program Research Objectives

This project was authorized to develop a "yardstick" for evaluating combat operations in the built-up environment. The effort was to provide a research tool to meet the need to integrate - in an evaluation sense - the operations of infantry, armor, artillery, and other combat and support systems into task organized force options for systematic, comparative evaluation.

To insure compatibility with related programs and applicability to developer and user needs, it was desired that close collaboration be established with the U.S. Army Training and Doctrine Command (TRADOC) and its schools and combat development activities and with the U.S. Army Material Command and its laboratories and systems analysis activities. Direct involvement with these organizations was sought, both at the command level and the operating levels. Additional liasion was to be maintained with field forces such as REDCOM, Berlin Bridgade, EUCOM, USAREUR, CINCPAC, as well as elements of the Marine Corps.

Specifically, the purpose of this program was to develop the research tools necessary for the systematic evaluation of advanced materiel and operational concepts, integrated into force structures tailored for military operations in built-up areas (MOBA). Previously developed concepts and analytic models of employment /ARPA-sponsored MOBA study contracts DAAH01-72-C-0922, DAAH01-72-C-1063, DAAH01-72-C-0960, DAAH01-72-C-0942/ were to be used to develop the analytic models and computer assisted games for use in assessing the combat mission effectiveness of new force unit structures compared with current baselines at levels up to augmented battalions. In the latter stages of the programs, the contractor was to prepare a final analytic model of urban combat to serve as a research tool for evaluating materiel concepts and tailored force options. Validation efforts were to accompany the gaming modes at appropriate stages of development.

The specific requirements of the research program comprised four original primary tasks:

- TASK I. Research Game and Analytic Model Specification. This task required specification of characteristics, procedural flow, design elements, validation procedures and support elements for the research game and analytic model.

- TASK II Design and Development. This task required design and development of the overall structure of the research game and analytic model, to include scenarios, assessment models, validation procedures, and support elements.

- TASK III. User Documentation. Task requirements included documentation of user procedures, detailed specifications and illustrations of equipment required. Documentation for the user analyst, giving the theory and detail of methodology employed were required.

- TASK IV. Exercise and Extended Development. This task required exercise of the gaming models developed for the purpose of determining and correcting weaknesses; and, the task required validation of final models and preparation of final version of user documentation.

The above four tasks comprised the original requirements of Contract DAAH01-74-C-0710, effective May, 1974. In July 1975, an amendment to the original contract, coordinated with representatives of the U.S. Army Training and Doctrine Command (TRADOC) added a fifth task:

- TASK V. MOBA Terrain Model for TRADOC European I Scenario. The task required development of a terrain model for the MOBA sequences of the European site selected by TRADOC for scenario oriented evaluation of forces and operational concepts. The model was to be suitable for use in the Gaming Models for MOBA developed under the original contract specification.

3. Research Study

The following summary of key points, both technical objectives and programming planning, marked the conduct of the research study. At several points during the study, severe disappointments were experienced in either the inability or long delay in obtaining key design data and materials. Three aspects of this are noted:

- In each case, previous investigation determined that the data or design material existed at a particular source and that it was potentially available.

- Failure or delay in obtaining necessary data or design material, despite efforts of the contractor, the sponsor and other government agencies, resulted from unexpected reluctance or refusal by the source to release the required data and design materials.

• Each such delay or lack of material necessitated compensating realignment of technical methods and/or program planning. In one instance, technical compensation to generate a substitute data base (terrain data for European Site 1) over taxed the program resources and was (primarily) responsible for a program shortfall.

Key points in the research study are summarized as:

(i) May 1974. Contract go-ahead on the research program was received; however, this go-ahead authorized pre-contractual effort, beginning March 1974. Initial efforts were applied to Task I, Specification.

(ii) October 1974. A report "Research Game Design Specification: Gaming Models for Military Operations in Built-Up Areas" was published. This report outlined the specifications and intended design route for (1) the gaming models structure, with predication on acquisition of the EINFALL Simulation as a design structural basis and terrain model development; (2) exercise and validation, predicated on parametrics (sensitivity) exercise of developed models; and (3) initial development of technical methods in a Test-bed Game.

(iii) January 1975. During the previous months, efforts to obtain the predicated EINFALL Simulation failed. As a result, it was reported:

> "A review of the technical plan of accomplishment was begun during December (1974). This review is directed toward internal adjustment of detail technical tasks to compensate for the non-availability of the EINFALL Simulation. The review, and resulting technical task adjustment is expected to be completed by 31 January 1975."

The final decision on possible readjustment of technical methods was delayed until after demonstration, review and critique of the Test-bed Game in February.

(iv) February 1975. By February, the major component modules of a Test-bed (design development) Game had been completed to a degree permitting a working conference demonstration. Such a demonstration was held on 11-13 February with participants from the contractor's staff, the sponsoring agency, various schools and development activities of TRADOC, Materiel Command, and the Marine Corps.

As a result of the Test-bed Game critique and the recommendations provided, discussions were held with the sponsor during late February and early March. It developed from these discussions that the sponsor strongly desired to maintain the

original technical approach, holding to the predicated (EINFALL-like) player directed simulation. It was recognized that this portended program stretch-out but the end-product advantages were deemed worthwhile. The result was a new effort to obtain the EINFALL Simulation through one of several possible sources: the FRG (originators of the EINFALL Simulation), SHAPE (users of EINFALL), and the U.K. (users of the original EINFALL and developers of EINFALL Mark II).

(v) July 1975. A major change in program plan occurred in July 1975. This resulted from (1) the acquisition of the full EINFALL Mark II Simulation from RARDE (United Kingdom), and the contract amendment adding Task V(MOBA Terrain Model for TRADOC). It was reported:

> "The overall objectives and plan of accomplishment remain unchanged; however, revisions incorporating the following basic elements are planned:
> 1. The overall objectives will be amended to accommodate a fifth task, that task being the adaptation of the MOBA Game Terrain Model to the (TRADOC) SCORES Western European Scenario Site.
> 2. The plan of accomplishment will be amended to reflect:
> (a) the insertion of the fifth task into the present program, beginning approximately 1 August 1975 and spanning to approximately 7 November, 1975;
> (b) essentially, deferral of present original program tasks from 1 August to approximately 7 November 1975, then resumption of the original tasks (approximately 15 weeks effort);
> (c) completion of (original) program plan by 29 February 1976;
> (d) the insertion of a new, low-level-of-effort sub-task to parallel the newly inserted (ARPA/TRADOC) fifth task and directed toward recovering the program slippage induced by the previous non-availability of the EINFALL Simulation."

(vi) September 1975. The principal Task V effort was being continued; however, a lack of basic data sources required a revision of technical methods. The required data was to have been Government Furnished Data (TRADOC) obtained from the FRG. Although like data (Maps) had been obtained previously for another terrain site, the required data for European Site 1 could not be obtained, although known to exist. The apparent cause was FRG reluctance to provide map coverage it considered to be sensitive. The revision of technical methods required the under-

taking of additional (unplanned) technical effort to create the effective equivalent of the required maps from a specially made area photomosaic and stereo photography. No other alternative (except abandonment) could be found for the requirements of Task V.

(vii) January 1976. The technical revisions necessary for the Task V effort contained unforeseen technical difficulties in execution. It was reported that those difficulties portended a program shortfall:

> "(1) A principal focal point of technical difficulties has been the add-on task ...
>
> (2) The original, primary source of the major focus of technical difficulties (lack of essential basic data source) was recognized and reported for the month of September 1975. Corrective measures initiated at that time required the undertaking of new, unprogrammed technical effort. That effort was deemed to be within program resources when reported. However, latent and unforeseen difficulties imbedded within the corrective technical effort developed during December 1975.
>
> (3) The additional technical design effort has now been completed, but has caused a severe shockwave in program control."

(viii) February 1976. The end of contract was reached with a significant program shortfall. At this time further effort was put in abeyance, pending Government decision (contracting agency) on disposition of the uncompleted program effort.

(ix) August 1976. A contract amendment was approved granting an extended funded period of effort for completion of the program by November 1976.

(x) This report contains the final technical results as of the extended contract completion date.

C. PROGRAM RESULTS SUMMARY

This program of research has designed, developed, and exercised a gaming structure comprising two distinct levels of gaming. The two levels of gaming are intended to be operated in conjunction to provide successively detailed levels of evaluation of a research problem. The two gaming levels are the Force Operations Level Game and the Unit Operations Level Game. Each game level utilizes a different operating version of a single game simulation called Military Operations in Built-Up Areas Combat Simulation (MOBACS).

Specific products of the program of research are:

Documentation

Volume 0: Final Technical Report

Volume 1: Methodology

Volume 2: Terrain Data Model; European Site 1.

Volume 3: MOBACS User's Manual

Volume 4: MOBACS Programmer's Guide

Computer Programs and Data

MOBACS Program (Magnetic tape and printout)

Terrain Data, Site 1 (Magnetic tape and printout)

Terrain Data, Site 2 (Magnetic tape)

Test-bed Game, Program (Not documented for release)

Raw Terrain Data, Site 1 (Magnetic tape; not documented for release)

Raw Terrain Data, Site 2 (Magnetic tape; not documented for release)

Terrain Data Reduction Program (Magnetic tape; not documented for release).

II. GAMING MODELS DEVELOPMENT

A. GENERAL

The research program required the specification, design and development of an analytical methodology to evaluate the utility of operational concepts and alternative materiel systems for military operations in the built-up area. This section describes the gaming models developed under the requirement.

1. Game Scope and Resolution

The MOBA Gaming Models are defined in terms of operational scope, the geographic areas of representation, modes of operation, and force representation.

a. Operational Scope

The MOBA Gaming Models have been designed to accommodate and integrate various types of land forces such as infantry, armor, mechanized and air mobile, together with support fire elements. The models provide for representation of the major types of conventional operations: offensive, defensive, retrograde (delay/withdrawal) and movement. The models also provide for specific built-up area operations which are special variations of conventional operations: attack/defense at built-up area perimenter; interconnected village operations; and, intra-city operation such as clearing, point defense and penetration on broad avenues of approach. The models permit definitive representation of the built-up environment and selective location of force units within the structural environment.

b. Geographical Areas of Operation

Game operations with the models may be conducted in either of two geographical locations. These locations have been termed European Site 1 and European Site 2. European Site 1 is the European site selected by the U.S. Army Training and Doctrine Command (TRADOC) for scenario oriented evaluation of forces and operational concepts. European Site 2 is a hypothetical site predicated on the West German city situation on the Rhine River. Each of these geographical areas is supported by a detailed terrain data model (data tape) covering an area of 10km x 10km.

c. Modes of Operation

The MOBA Gaming Models have been designed to permit maximum flexibility of use in research applications, and to provide the basis for a systematic, recusive (iterative) investigation of research problems. The primary method of achieving this

capability is the provision of two distinct game modes of operation.. These two modes of operation are identified as the Force Operations Level Game and the Unit Operations Level Game. In addition, it is intended that the Force Operations Level Game be preceded with a planning map exercise to provide detailed operations plans for the operations to be gamed.

The intended modes of operation are corrolated with specific command levels (Figure 1), and are described as follows:

(1) The planning map exercise is intended to simulate the division/brigade planning operations; it is intended to produce detailed Brigade (threat Regiment) operations plans upon which to construct the detailed game input for the Force Operations Level Game.

(2) The Force Operations Level Game provides for simulation of Brigade (threat Regiment) sized combat operations, with an approximate unit resolution of platoon-sized units. The game is fully team interactive (Blue and Red) and operates in cyclic mode. That is, players input unit orders and instructions at the beginning of a combat period of play (cycle); then, the combat action of that period is simulated in the force operations version of MOBACS*; results of the combat period simulation are returned to the respective players; and, a new cycle is begun. The length of a combat period (cycle) is variable throughout the game, but a nominal period is approximately 15 minutes of combat time. Completion of game play, and the generated combat history is used to isolate specific, critical unit (e.g., company) action sequences; these sequences provide the detailed scenario input to the Unit Operation Level Game.

(3) The Unit Operations Level Game provides for simulation of approximately company level operations, with resolution ranging down to squad or fire team level. It is intended that this game be operated as a closed, end-to-end simulation of a combat sequence with player-analysts developing a complete input scenario through open, scenario-like evaluation of unit actions and options. When operated in the closed simulation mode, the game permits input for automatic, parametric replication of game play. The game may be operated alternatively in the cyclic mode; however, under this mode, automatic parametric replication may not be employed.

*Military Operations in Built-Up Areas Combat Simulation

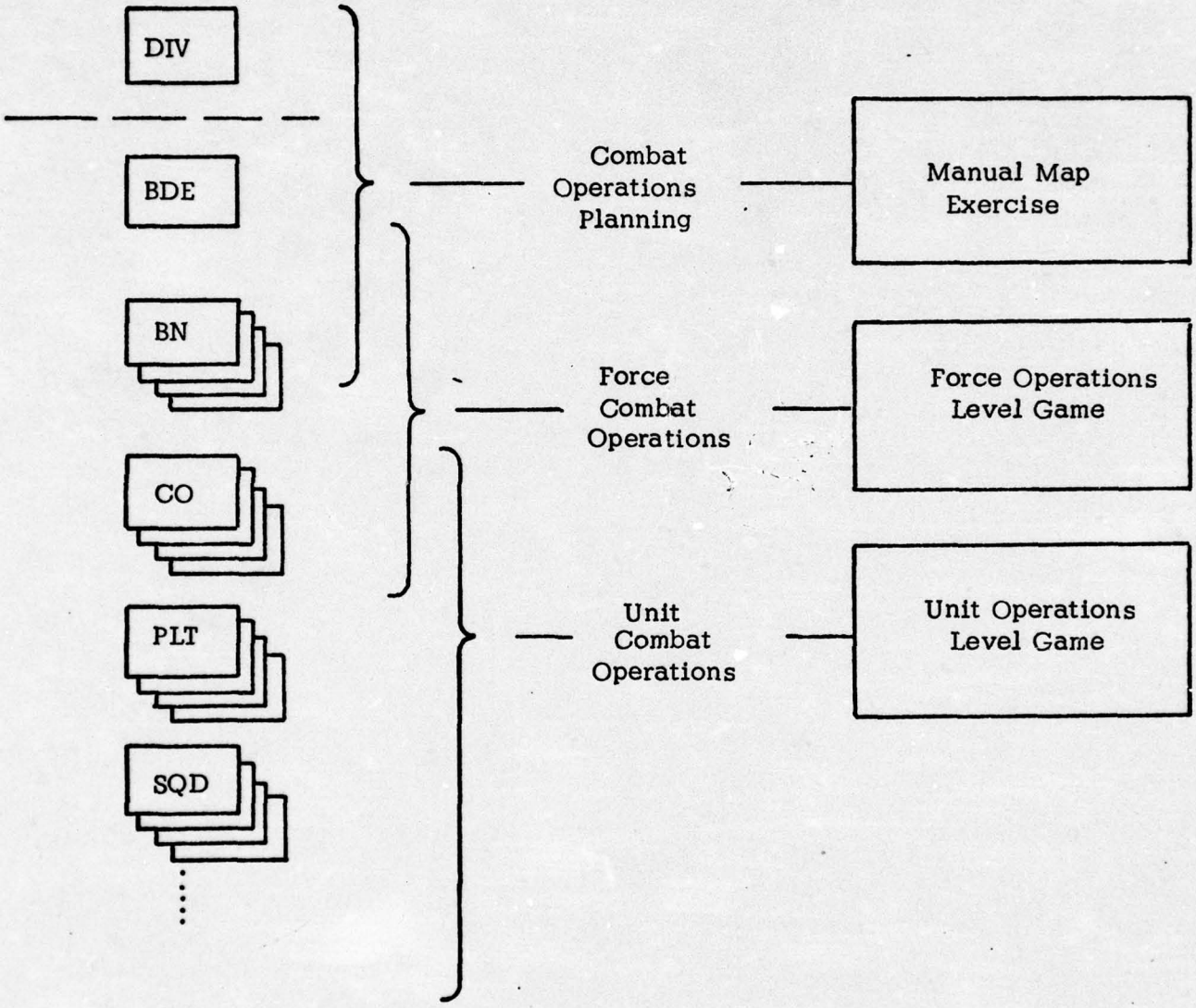


Figure 1. Game Scope and Resolution

The modes of operation provide for the examination of a research problem a successive level of details in a connected sequence (Figure 2). It also provides for iterative investigations of the basic research problem. Detail results from analysis with the Unit Operations Level Game can generate scenario amendments for replay in the Force Operation Level Game. Similarly, Force Operations Level Game Play may suggest revisions in the original operations planning and dictate a recycling of the planning map exercise phase.

d. Force Representation

A basic structure is provided which permits considerable flexibility in the simulation of a combat organization; and, the same basic capability exists in both the Force Operations Level Game and the Unit Operation Level Game. In either game three categories of units are defined: command units, maneuver control units and battle units. Battle units are the basic units of resolution. A battle unit, provided consonant input battle unit data are given, may represent a combat unit of almost any size and need not be any organizational unit. Battle units represent more or less cohesive units and are classified by type. Definition of battle units must be with reasonable regard to homogeneity with respect to vulnerability class, weaponry and modes of tactical operation. Variable resolution (variable size battle units) may be employed within a force structure.

Command units represent the organizational command points to which battle units or subordinate command units report. The functional uses of command units are: (1) to organizationally structure an overall force with up to five echelons of command; (2) to receive player input orders and to issue them to subordinate units for execution; and (3) to assemble the intelligence information of subordinate units for report to the player. Maneuver control units are specially designated command units used to represent tactical control grouping within a command; as such, they may, or may not, have direct equivalence to an organizational unit.

All units are named and indexed according to their hierarcial position in the organizational structure. Thus, players must pre-define their organization for combat with due consideration for the particular scenario to be played and the intended level and detail of tactical control to be used throughout the scenario. Battle units, and effectively, game resolution, are defined by various types of battle unit data.

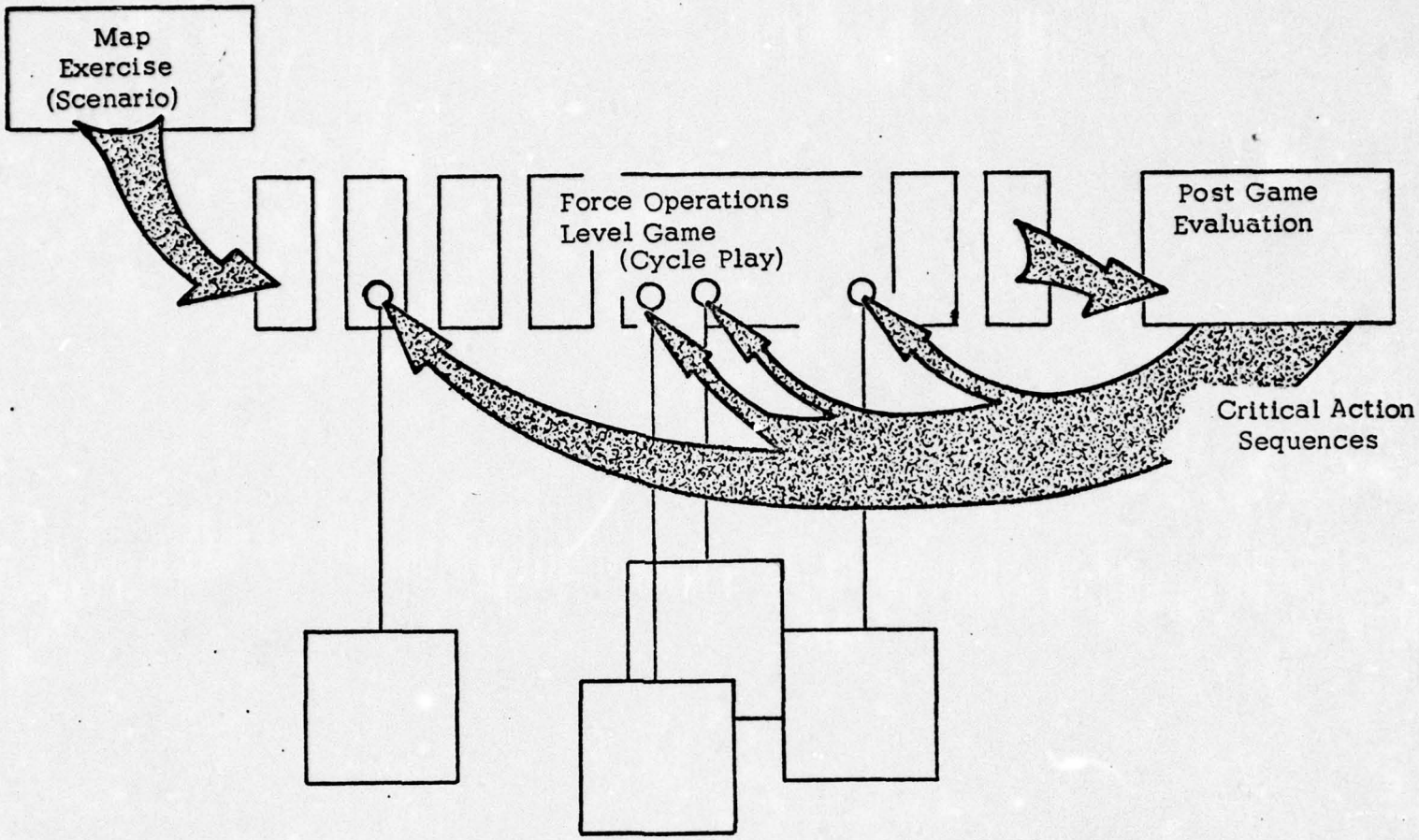


Figure 2. Game Modes of Operation

Virtually any task organized force may be represented subject to the general limitations:

- Maximum number of all types of units per side may not exceed 200
- Maximum number of immediately subordinate units reporting to any command or maneuver control unit may not exceed 9
- No changes in organizational (reporting) structure may be made during game play.

Force capabilities are described by two primary blocks of data: (1) unit capability data for all battle units with variable data for different unit activity states; and (2) weapon capability data, including support fire mission data. No specific data is input for command units or maneuver control units other than definition of their hierarchical force structure position.

2. Research Application

The MOBA Gaming Models have been designed as a research tool to be used in a research mode. In the research mode of application, the Gaming Models are designed to evaluate the following range of research problems:

- Force Structure and Mix. The models permit wide lattitude in structuring forces and in defining the capabilities of the individual unit elements making up the force. The specification of force structure is completely open and is defined by game input data. Comparative evaluation of alternate force concepts using the Force Operations Level Game is the primary mode of research problem evaluation. Additional, "snap-shot" analyses may be made using the Unit Operations Level Game.
- Doctrine and Tactics. Evaluations of doctrine and tactics may be made using either the Force Operations Level Game or the Unit Operations Level Game. Selection of level is dependent upon the doctrinal or tactical level to be investigated. Representation of the doctrinal and tactical use of defined units of resolution is incorporated through the sequences of player input orders to units. Representation of detailed doctrinal and tactical methods within defined units of resolution is incorporated through interpretation of input data describing each of the units in each of several permissible states of activity. Comparative analysis of concepts is the intended mode of overall evaluation; detail evaluation is obtained through the use of the Unit Operation Level Game and the parametric analysis capability of that game.

- Weapon System and Weapon Mix. The models permit evaluation of the effects on operations of various mixes of weapons, both among defined units of resolution and within defined units of resolution. Basic, multiple weapon types may be represented for each unit of resolution; and, each of these weapon types is defined by weapon capability input data. Comparative analysis of force mixes of weaponry is made with the Force Operations Level Game, while more detailed analyses of unit weapon mixes may be made using the Unit Operations Level Game. Parametric analysis of variations of weapons characteristics data may be made using the Unit Operations Level Game.

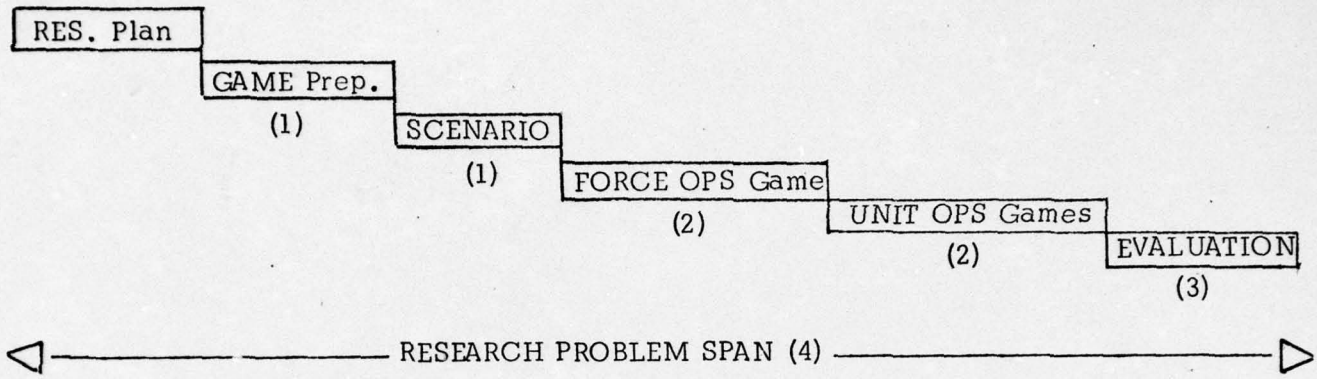
- Materiel Systems. Limited investigation of materiel systems may be undertaken in a manner analogous to that for weapon systems. However, specific materiel systems characteristics must be indirectly represented in the input data by their resultant (elemental) effect on unit capability or weapon capability.

The MOBA Gaming Models are intended to be flexible and responsive to a variety of research techniques. The models may be applied as formal game structures; or they may be stripped to pure simulation games with research analysts synthesizing the dynamic player inputs. A general framework of research problem application is suggested in Figure 3.

3. Research Analysis

a. Single Force (Concept) Evaluation.

The single force evaluation method is based on the selection of appropriate measures of effectiveness (MOE), and the evaluation of the resultant MOE values obtained with a single force or concept under varying conditions (e.g., variations of situation). The MOE are stated and measured by specific performance parameters, the values of which are obtained from the time history output data. Based on examination of MOE response, performance parameter values and subjective evaluation (of Force Operations Level Game output), critical small unit action sequences are chosen for examination by parametric analysis in the Unit Operations Level Game. The MOE variation analysis of interest is defined; this in turn is defined in terms of output performance parameters; then, a specific variation experiment is structured in terms of input data parameters to drive the output performance parameters through a response range. This variation experiment (or series of variation experiments) is then evaluated in the Unit Operations Level Game, using the parametric variation option.



(1) Game preparation and input data preparation are characteristically interleaved with the scenario map exercise.

(2) Iterative cycles of detail scenario (operations plans) and Force Operations Level Game play may be desirable. Similarly, iterative cycling between the Force Operations Level Game and the Unit Operations Level Game.

(3) Evaluation is more properly a concurrent function of each game, particularly if iterative cycling of games is used.

(4) Typical research problem spans may be four to six months.

Figure 3

Gaming Within the Research Problem

b. Force (Concept) Comparison Evaluation.

The objective of comparative evaluation is to provide a series of standardized trials of multiple force (concept) options. While it is normally advantageous to establish specific MOE, as above, the primary thrust of analysis is to (1) establsih the standardized trial (including baseline concept); (2) subject each force or concept to gaming under the standardized trial condition; (3) examine the initial gaming outcomes through subjective analysis to isolate areas for detail investigation; and (4) subject the isolated areas to parametric analysis.

Establishment of the standardized trial normally requres gaming (perhaps iterative gaming) with the selected baseline concept to fix a standardized scenario of game play operations. The development of comparisons is achieved by systematic replay of the game play operation, substituting each time a desired force concept or weapon mix. Initial comparative gaming is assumed to be accomplished with the Force Operations Level Game. The multiple case outputs of this game are then examined by subjective analysis.

The subjective analysis includes the comparison between the subordinate units or systems of each force (concept). The purpose of the subjective analysis is to synthesize the reasons for unit/system performance and to evaluate the military significance of any trends or variations observed. This examination includes a review of the background battlefield conditions, the missions assigned to units, and the orders given to them for the performance of those missions. The synthesis of insights into differences in performance provides the basis for selecting critical action sequences for examination in detail.

The critical action sequences are described by standardized (detail) trials for play in the Unit Operation Level Game. Additionally, a variational experiment on input parameters is specified. The critical actions are then gamed, and the output response functions are examined to provide a detailed basis of comparative evaluation among concepts.

4. Operation and Installation

The original research program was sponsored by Defense Advanced Research Projects Agency as a stimulative research effort in MOBA. No definitive user or user site was defined as an application (or installation) goal for the project. In the later stages of the program, the U.S. Army Training and Doctrine Command (TRADOC) expressed its intentions as a potential user through participation in the program. However, that (TRADOC) participation did not extend to specific user

site selection or installation.

It was recognized that several aspects of detailed procedural definition of necessity, are highly specific to the intended user application, the gaming facility, and the computer support facility. This dependence on a specific user installation required the adoption of design criteria which can be summarized as follows:

- Gaming models would be completely designed, and developed to the point of "facility interface."
- User installation, subsequent to the present research program, would include detailing of facility related game play procedures, adaptation of computer programs to the user's computing system, and compilation of a general game data bank specific to user application.

All components of the gaming models within the "facility interface" definition - principally the computer programs, terrain data, and game input structure - have been fully developed and exercised. Beyond this a general game play procedural structure has been designed which should permit relatively easy procedural detailing for a given user facility.

Within the above context, summary items pertinent to installation and operation are:

a. Computer

All machine programs are presently programmed for the CDC Cyber 73 computer (compatible with the CDC 6000 series computers). Magnetic tapes of all pertinent programs are available. The programs are written in FORTRAN IV language to facilitate transfer to computers other than the CDC series. However, potential user's should recognize that some reprogramming may be necessary for operation on computers other than the CDC series. For example, terrain data tapes use a data storage technique dependent on a 60-bit word structure; thus reformatting of terrain data may be necessary for computer operation on other than CDC equipment.

To facilitate program transfer to other computing equipment, extreme care has been taken to copiously annotate programs with comment statements. This is intended to give maximum assistance to programmers in translating programs.

b. Support Requirements

Detailed definition of game staff support requirements is dependent on the specific user application and is general on the installation facility. A general statement of game staff support requirements is estimated in Figure 4.

GAME LEVEL	PLAYER TEAM	CONTROL TEAM
(Scenario Map Exercise)	1 Division Co 4 Division Staff 2 Administrative Clerk	Game Planning Staff
Force Operations Level Game	1 Brigade Co 1 Div TOC/FDC 4 BN Co 2 Program & Status	1 Game controller 2 Team Control 3 Program & Status
Unit Operations Level Game	3 Player/Analysts	1 Game Controller 2 Team Scenario Control 3 Program & Status

Figure 4. Estimated Game Support Staff Requirements

B. METHODOLOGY

This section discusses in general terms the methodology employed in developing Gaming Models for MOBA. The discussion centers on the various analytic methodologies used in developing (1) the terrain data model, (2) the urban terrain related function imbedded in the MOBACS simulation, the methods of player employment of forces in the game, and summaries of combat function representation.

1. Terrain Model

Initial review of the requirements for terrain data representation in the built-up environment confirmed original program assumptions that neither a suitable terrain model nor a suitable established technique for modeling built-up area terrain and terrain features existed. The built-up environment is difficult to model because it displays numerous, irregular variations in height and other pertinent parameters. Terrain models suitable for open (rural) areas cannot provide sufficient resolution of the fabricated structure of built-up areas without requiring excessive data storage and manipulation. As a result, it was necessary to develop a new terrain modeling technique.

The terrain modeling technique developed is comprised of a two-step modeling process to arrive at a game (program) terrain model. The first is the terrain data base model; the second is the program terrain (data) model, obtained by a data sampling and reduction process run on the first (terrain data base model). Since the first model was an interim research product, the computer model for compiling the data tape was not documented, but computer listing of both the compilation program and compiled data are available.

Model data fills were made for two separate built-up areas. The first area (shown in Figure 5) provides a general use data base created for a "typical" Western European area. This area covers 10km x 10km and includes such features as a sizeable urban area, outlying village areas, open and wooded areas, major water areas (rivers), prominent terrain elevations and rises, and a well-developed transportation net of major highways, roads, bridges, and railroads. A reasonably full range of structural types, arrangements, and groupings is represented. The second area is a special application data base created for a built-up area within the overall U.S. Army TRADOC SCORES Western European Scenario (Figure 6). This area contains most of the general area features of the first area, with the exception of major water areas, and smaller size and less developed nature of the "typical" built-up area. Due to severe restrictions in obtaining original source data for the

Figure 5

Typical Built-Up Area

Figure 6. Western European Site 1

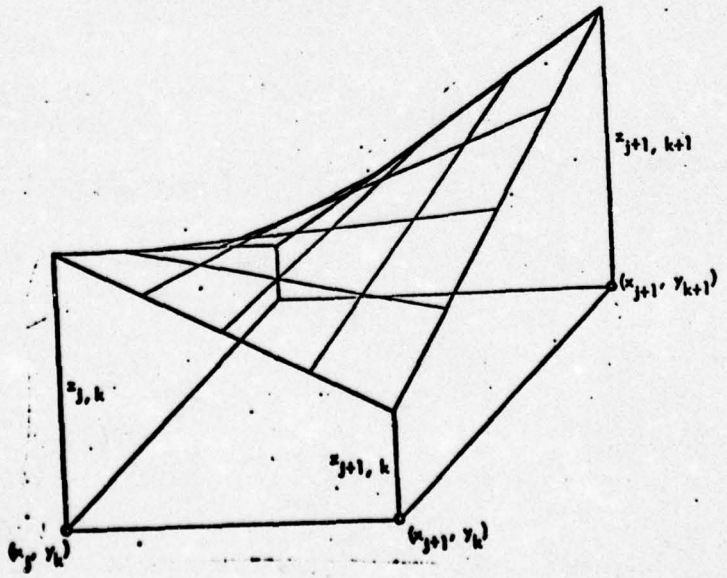
second area, it was necessary to restrict the overall coverage of the second area to 9km (north, south) by 8km (east, west).

a. Terrain Data Base Model

If there were no computational constraints, a single model could accurately describe the geometry and properties of the surface, structures, vegetation, and natural features, with a sufficiently small unit of resolution. For example, 5 meter squares give accuracy but incur some 4 million storage points for a 100km^2 urban area. Employing 10m by 10m squares gives 1 million stored points, with a significant sacrifice of accuracy of representation. With a 25m by 25m square, accuracy deteriorates to an unacceptable level.

It was decided to employ two complementary representations for the urban environment: the quadratic surface representation, used in the surface relief, area vegetation, and natural features models, and the rectangular representation, used in the fabricated structures and linear vegetation models.

The surface relief model provides earth surface elevations above mean sea level. It is based on the relief model originally developed by G.W. Evans at the Stanford Research Institute. The technique has seen extensive application in the Small Independent Action Forces (SIAF) Program under ARPA sponsorship. The model employs a Cartesian coordinate system, with the coordinate points uniformly spaced on the XY (mean sea level) plane. The elevations at the four corner points of each grid rectangle are algebraically weighted to construct the equation of a quadratic surface within each grid rectangle, as illustrated below, and the surfaces are continuous between grid rectangles.



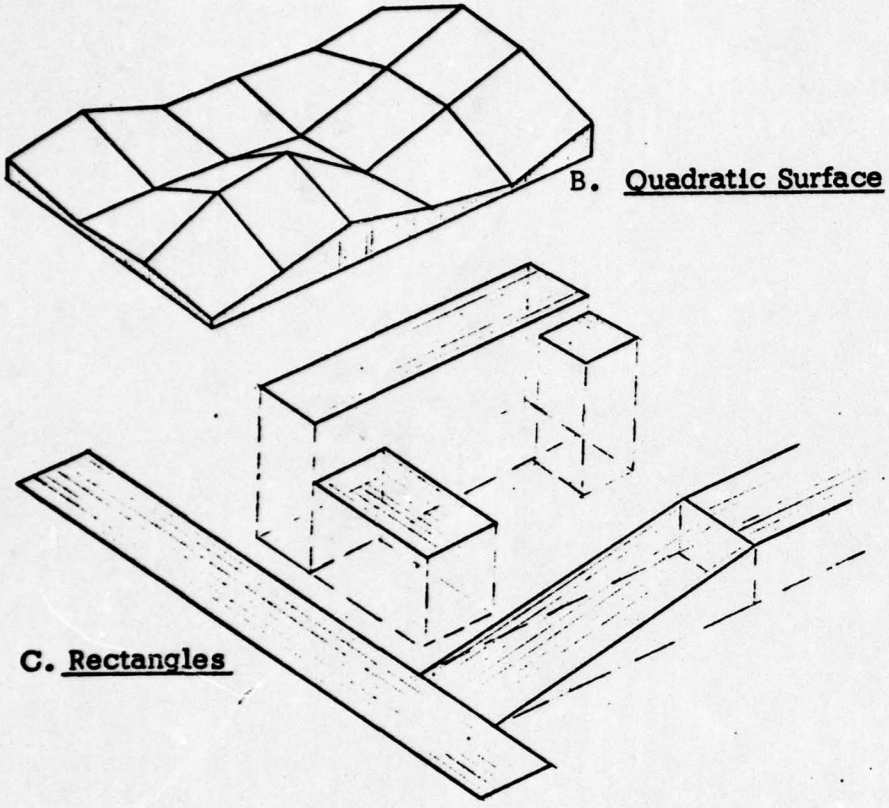
The number of grid squares needed to form the 100km^2 terrain model area depends on the size selected for the grid squares, and that depends on the data gathering, storage, and computing constraints. Grid squares 40m x 40m were selected for this model, for a total of 62,500 grid squares.

In the fabricated structures model, structures are represented by rectangles, which in turn are represented by line segments together with an associated width and height (above the local surface), where the height is given for two opposite ends of the rectangle. Each line segment is stored in the data base as two points. Each pair of points has associated with them the XYZ coordinates, a half-width, and a code which represents descriptors, such as structural class, space density, etc. Where possible, several structures were represented by a single rectangle. For example, a row of attached town houses may be depicted by a single rectangle.

Figure 7 illustrates a portion of an urban area, shown in Figure 7A, together with the two representational techniques employed to simulate that area: the continuous, quadratic surfaced grid squares depicting surface shown in Figure 7B, and the rectangles depicting buildings and roads, shown in Figure 7C. Figure 8 shows the appearance of the urban area when buildings and roadways are represented by rectangles (the railway has been excluded here for clarity).

b. Data Acquisition Difficulties

The terrain data base model technique was developed on the basis of source data materials found to be available for the first (originally specified) "typical" Western European area. These source data materials were essentially unique; no alternate sources could be located. Accurate location and plan-form data on structures and streets was required, but only one up-to-date source could be found: the FRG Civic (City) Plat Map Series. It was determined that the conventional base terrain data source -- DMA digitized data -- simply does not exist for any built-up area; digitized data are available in Western European areas up to the perimeter of built-up areas, but do not exist within the built-up areas. Hence, the terrain data base model was premised in a fundamental way on the Civic Plat Map Series, with stereophotography and regular series 1:50,000 maps as supporting data.



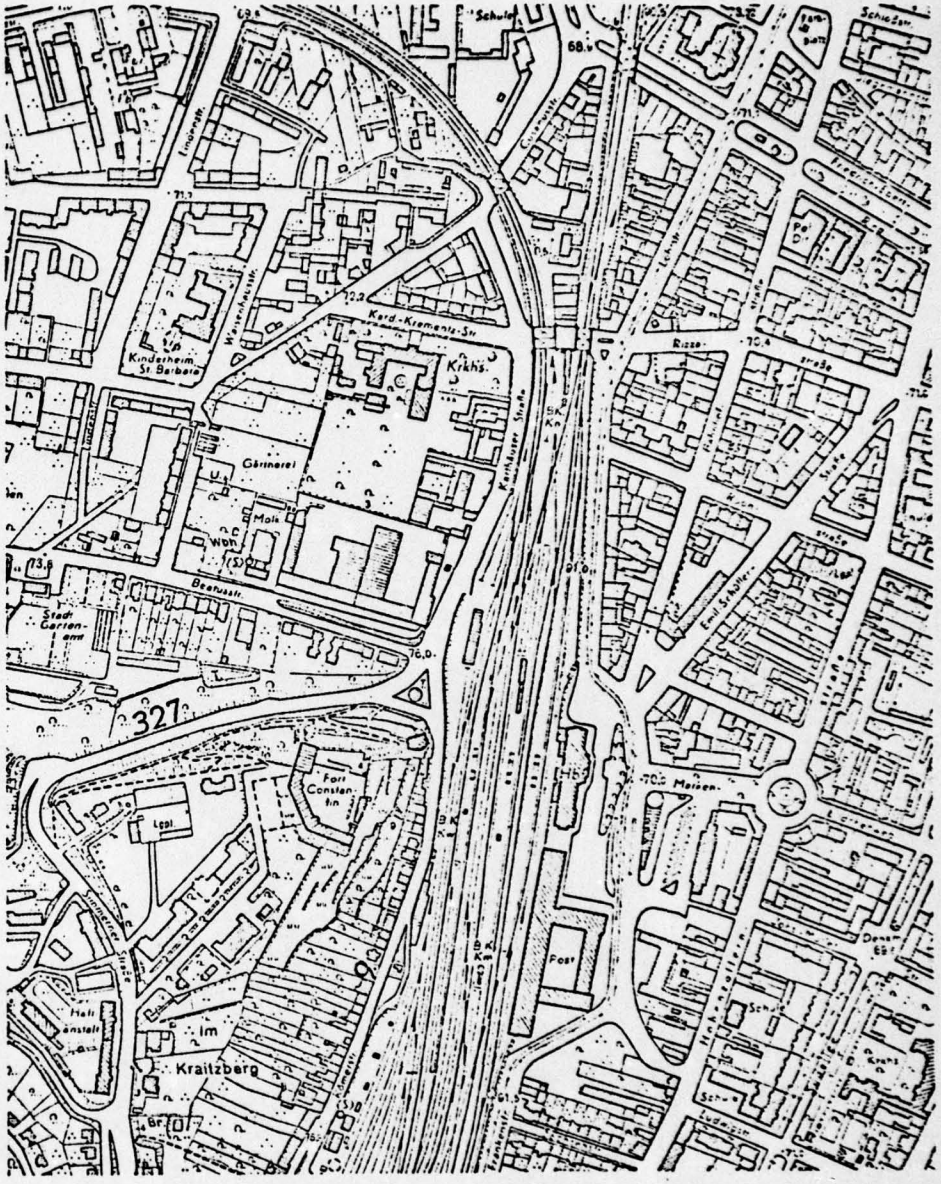


Figure 7. Urban Area Representation

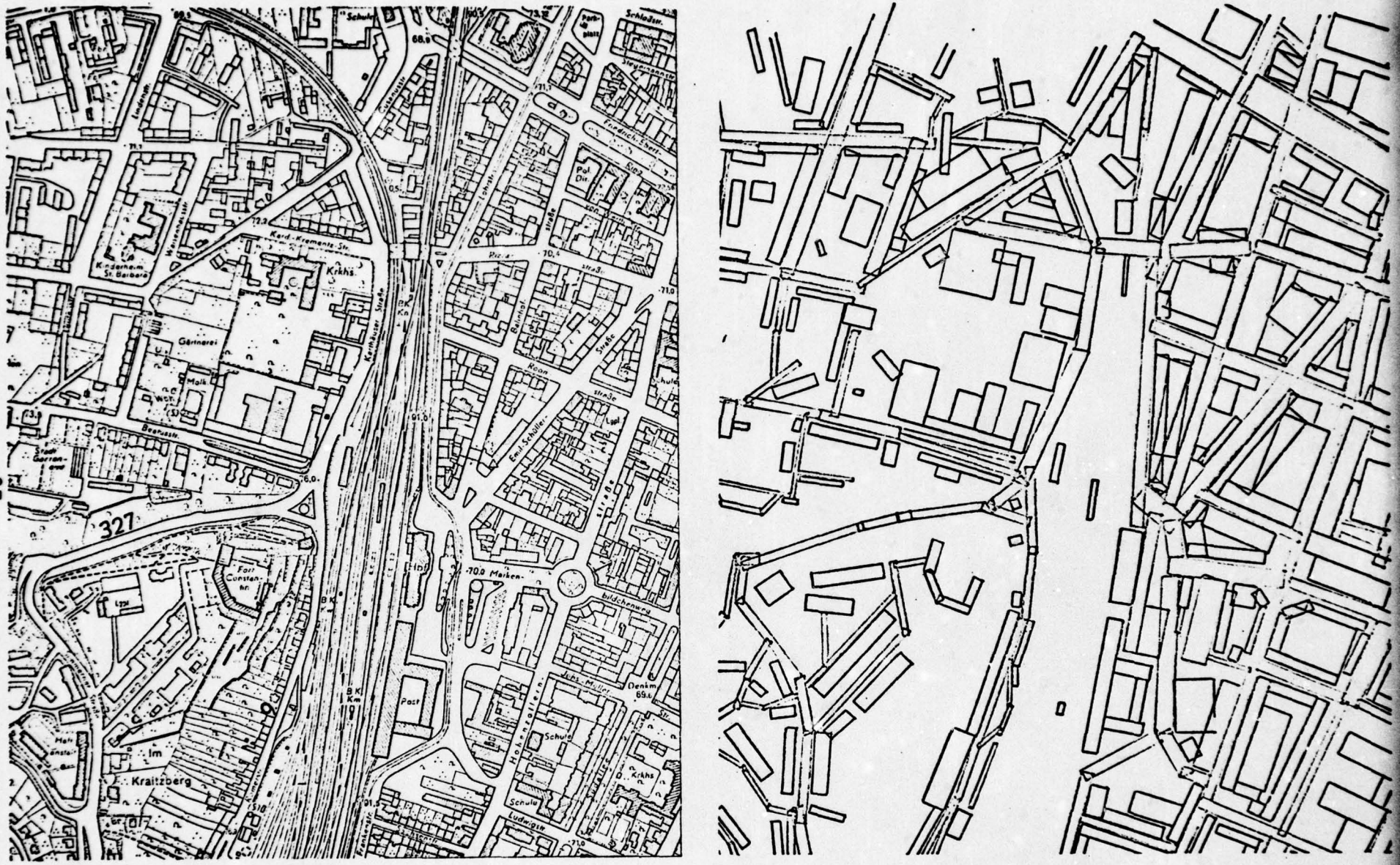


Figure 8. Rectangles Representing Buildings and Streets

As an additional task, a second area data fill was undertaken for the USA TRADOC SCORES Western European Scenario site. This additional task was undertaken with the provision that original data sources (particularly the Civic Plat Map Series) were to be government furnished. The existence of complete Civic Plat Map Series coverage of the desired areas was verified; however, neither the government nor the contractor was able to obtain them. Although it could not be confirmed specifically, it appeared that the FRG was quite sensitive about them, and hence reluctant to provide the required coverage.

The lack of the fundamental data source required a search for alternate technical methods, which were generally grouped into two categories: (1) redesign of the basic terrain model method to avoid dependence on basic planimetric data, or (2) additional technical design tasks to create an equivalent substitute for the basic planimetric data. The first alternative implied "synthetic design without data" and was considered unacceptable and rejected. The second alternative was found to be feasible in the following way:

(1) Low altitude sterophotography (approximately 1:5,000 scale) was found to be available within government sources. The photographic coverage available, however, was 9km x 8km rather than the desired 10km x 10km area.

(2) A carefully prepared photomosaic of the area was constructed from the stereophotography, but this photomosaic did not incorporate photogrammetic corrections.

(3) Photographically enlarged prints of sections of the photomosaic were prepared and detailed overlays (equivalent to the overlays for the "typical" area) were manually traced on light tables, with supplementary stereo photo interpretation. This produced a preliminary platform location of features still subject to the photogrammetric distortion of the stereophotography.

(4) Matching scale map enlargements were prepared to correspond to photomosaic (enlargement) sections. These were carefully superimposed on major location features, then the map grid coordinate system points were transferred to the photomosaics. On the basis of these points, planimetric corrections were computed for the photomosaic.

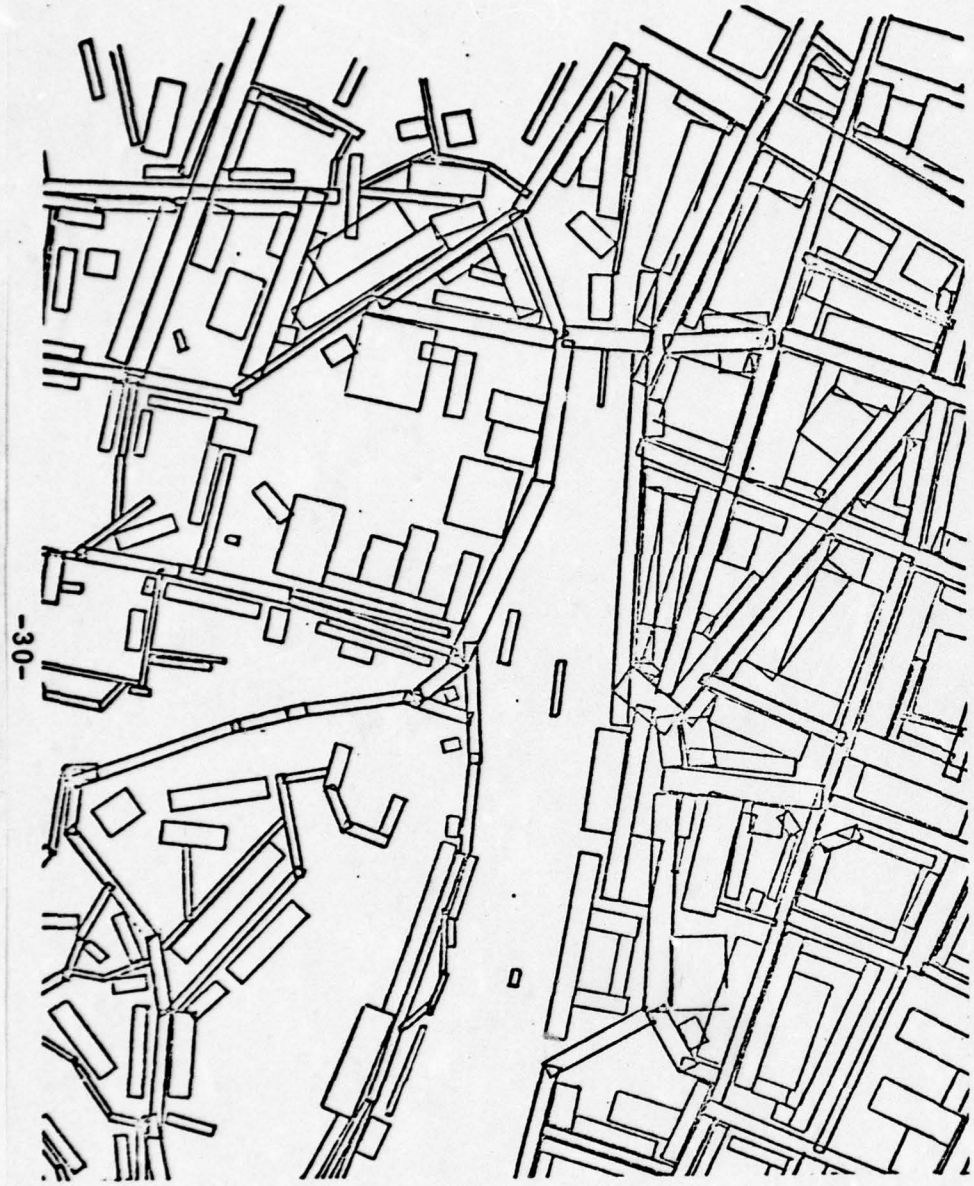
(5) A computer program was written to apply to proportional planimetric correction values to all feature (rectangle) coordinates from the overlays.

c. Program Terrain Model

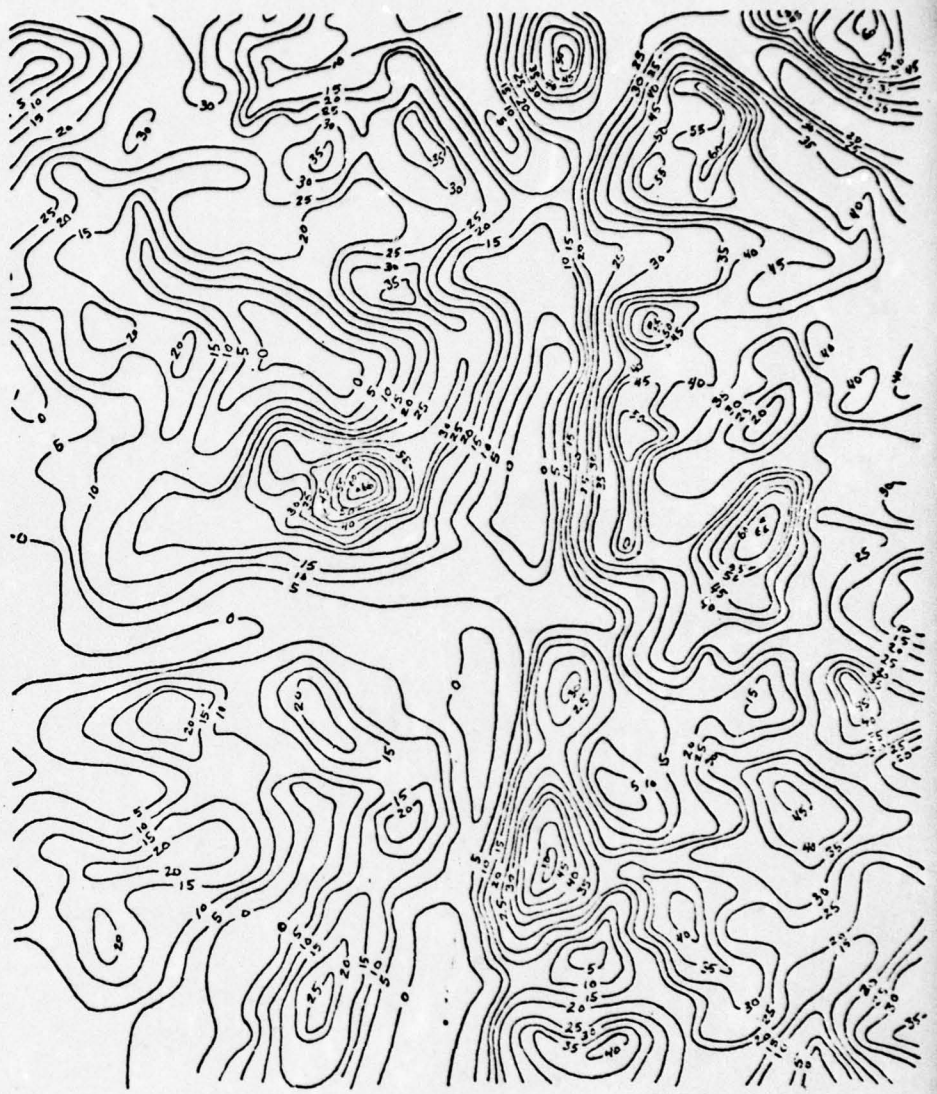
A basic Terrain Data Base Model was considered to have primary value as an original-source terrain data model, but not as an active model within the MOBA Game program. The terrain data model was simply too large -- approximately 250k words -- and the applications functions -- e.g., intervisibility -- required too much CPU time to compute by at least an order of magnitude. The CPU running time problem was rooted in the fundamental nature of the data base model and being discrete in the representation of surface features, leading to a large number of descriptors for the surface and rather flengthy geometric calculations of spatial relationships for the applications functions. As a result, it was necessary to consider a reduced, second-order terrain model for incorporation into the MOBA Game simulation program.

Preliminary hand sampling and analysis showed that structured features on the terrain surface could be recreated in reasonable detail of representation by "density surfaces" constructed over the terrain surface area of interest. In general the probable occurrence of a structure element can be predicted by a density surface of the value of (local) average square meters of structure planform area per square meters of (local) sample area. Ordered, interpolated sampling for this density value over the entire area produces the desired surface density function. In an analogous fashion, additional density surfaces can be produced for the conditional structure height and structure hardness (cover or protection function).

In general, density surfaces gave acceptable sharpness of flexure and response over the surface. This is illustrated by the sample terrain area in Figure 9A and the accompanying structure density contour of the same area shown in Figure 9B. However, it can be seen that sharpness of surface response is not sufficient to give sharp delineation of streets among, and separating, blocks of structures. Reasonable delineation and differentiation of streets from structure areas was an underlying requirement imposed by the functional modeling within the game structure; hence it was necessary to include an additional surface density of street area that could be "subtracted" from the street density surface.



A.



B.

Figure 9. Structure Density Contours

The "density surface" technique, together with other coding, was used to generate a complete data model. For "density surface" representation, a data value is stored for each 50M grid-square corner point, thus allowing a quadratic surface to represent the denisty value over the grid square. Other data values are stored as homogeneous values for the entire grid-square. The data stored in the terrain data model are:

Surface Representation

1. Terrain surface elevation
2. Structure density
3. Structure height above surface
4. Structure vertical hardness
5. Structure horizontal hardness

Grid Square Data

1. Grid Square classification
2. Vegetation classification
3. Trafficability classification
4. Critical local slope

The assembled terrain data model requires one computer word to store all values associated with one grid-quard, resulting in a computer storage requirement of 40.4k words for a 10km x 10km area.

2. Terrain Related Functions

Four primary terrain related functions required special analytic methodology because of the uniqueness of the built-up area environment. These are intervisibility, movement, structure hardness, and structured area target effects.

a. Intervisibility

Intervisibility is defined as the expected fraction of all possible line-of-sight pairings between an observer unit and a target unit (each with multiple elements), which are unobstructed. Intervisibility is not a single line-of-sight; it is the average condition of line-of-sight. A statement of intervisibility is obtained on the basis of the probability that there is no intervening element of structure, vegetation or terrain surface. The probability of the existence of an element of structure, vegetation, or terrain structure is obtained from the terrain data model for a succession of points along a "looking line" between two units,.

The probability functions for intervisibility were developed through two complementary investigations. First, sample structure density values were developed for a typical 1 km x 1km area. Random looking lines were drawn on this area and

examined for the probable interrupts. This data was used to develop empirical functions representing intervisibility. Second, a discrete line-of-sight sampling program was created to test the occurrence of intervals of line-of-sight in the original raw terrain data base. The distribution of interval lengths was examined and a confirmation of the empirical functions was obtained.

b. Movement

In the game, each battle unit has, as one of its defined input values, a standard maximum speed. This unit speed is the maximum speed a unit can make under the best mobility conditions of a level stable surface in the open. This maximum speed is degraded as a function of the local terrain slope, trafficability, structure density and road density. Impediments to movement such as barriers are represented by special input defined as environment areas.

For each short interval of movement (calculation time step), the forward line of unit movement is divided into sample points. For each of these sample points, the terrain model is interrogated for values defining local slope, trafficability, structure density, and road density. These values are used to calculate an expected forward movement rate for the unit. This expected forward movement rate may be further degraded by a local environment area (barrier, etc.) and suppression or immobilization.

c. Structure Hardness

The original, raw terrain data gave explicit architectural and materials coding to each structure. It was necessary to find a more generalized, more compact method of defining a specific hardness function. The adopted method is based on a statement of a structure's resistance to penetration.

This statement of resistance to penetration must consider both the structure and the penetrating round characteristics; however, the precise matching of round and structure does occur until an actual fire event is generated. Thus, it was desirable to formulate an expression for penetration which clearly separated the round penetration capability from the structure resistance (to penetration) capability. Research efforts indicated that four separately authored empirical equations for various materials penetration functions could be reformed into a single approximate expression of the following form.

$$\text{inches penetrated} = \frac{\text{round characteristics}}{\text{materials characteristics}}$$

With this general formulation, round characteristics are carried as weapon data (structure penetration factor), while materials characteristics are carried as terrain data (vertical hardness and horizontal hardness). Vertical hardness for a structure is based on a typical horizontal (floor) cross section for the structure and considers both material type and thickness. Horizontal hardness is based on a similar vertical (wall) cross section. The structure penetration factor of a weapon (round) is based on its type velocity, diameter, and weight.

Structure hardness values are used in calculating the effective cover when a unit is located in or among structures.

d. Structured Area Target Effects

The problem of representing terminal effects of munitions in structured areas is of primary concern to modeling military operations in built-up areas. At the same time, it is a subject for which no cohesive body of either representational techniques or experimental data exists. However, selective and widely scattered fragments of both techniques and data do exist. An overall terminal effects model was structured on the basis of the available, fragmentary material. Primary support for the research effort came from two previous studies performed by the contractor:

- "A Follow-on Effort on Phase II of the USABRL Bunker Vulnerability Research Program."
- "Mask II Model Design Notes" (independent development; not published for distribution).

Using available data, a terminal effects model was constructed which consists of three separate determinations: the probable number of effective hits on a structure, the probable penetration given an effective hit, and the lethal effects given an effective hit and penetration. The second determination, probable penetration, can be made rather directly from the structure hardness/penetration function previously described. The third determination, lethal effects, can be made on the basis of a mean area of effectiveness (MAE) derived from charge weight of a round. Thus, MAE can be entered as weapon data.

The first determination, probable number of effective hits, is commonly referred to as the "masking function". It requires determination of an estimate of whether a round will be a roof, wall, or surface impact; and, for a roof or wall hit, the angle of impact is required to estimate a riccochet function. Empirical data on masking (interruption of trajectory) was generated using the contractor's "Mask II Model;" this data was reduced to empirical equations. Additional research during the program developed a mathematical model of probable angle of impact of a round on a structure surface. This model, coupled with estimating functions for the critical angle of riccochet of a round permits calculation of the probable loss rate on rounds due to riccochet and/or masking.

The structured area target effects calculations require terrain data values for structure hardness, height and density. The calculations are incorporated in the combat attrition functions.

3. Employment of Forces

A significant feature of the methodology is the high degree of flexibility permitted in the representation of combat situations. This flexibility stems from the ability to specify sequences of employments and related actions for units, and to specify contingent conditions under which sequences of action will be initiated, modified or terminated. With such sequences of action, it is possible to develop complex patterns of tactical operations.

All employments, maneuverings and control of force units are done in the simulation as a result of player input orders. In the Force Operations Level Game, players may input periodic sequences of orders (at the beginning of any cycle). These sequences can be as brief or as long as desired, and they may be either amendments of or extensions to previous sequences of orders. In the Unit Operations Level Game, the complete end-to-end sequence of unit orders for the situation is input as original input.

The available order set is the same for either level of game operation; however, the categorically defined unit activity states invoked by the unit employment orders may be substantially redefined by input data. Thus, an attack order given to a company in the Force Operations Level Game will evoke a characteristic company unit action. The same attack order, given to a squad in the Unit Operations Level Game will evoke different characteristic actions appropriate to the squad.

The available order set may be grouped into four categories: (1) employment orders, (2) support fire orders, (3) conditional orders, and (4) instructions.

The available order set constitutes a logical instruction set by which players maneuver and control units in the game. As such, the order set has strict procedural requirement for use. Input sequences of orders must be logically sequenced, and linked together, very much in the nature of a highly simplified programming language. Thus, if a player uses an IF order, he must specify alternate sequences of orders - one for a "yes" condition and one for a "no" condition - and must specify these branches on the IF order itself. It is necessary that players be thoroughly familiar with the procedural rules for utilizing the available order set.

a. Employment Orders

Employment orders are the principal orders by which activities, movements, and disposition of units are effected. An employment order specifies a fixed sequence of combat "phases" through which the battle units of a command must pass to effect the employment. There are four sequential phases of activity, and one or more of the phases may be a "zero-activity" phase, depending on the particular employment. The phases are identified as (1) ploying, (2) moving, (3) deploying, and (4) holding. Within each phase there are several possible statuses; and, the statuses, taken together define the possible activity states for battle units. Thus, an employment (order) is a defined sequence of statuses, at most one from each phase, which the battle unit is to execute. A summary of available employments is shown in Figure 10. Note that battle unit type data is input by status. Thus, the invocation of a particular status calls into effect a particular battle unit capability.

Examination of Figure 10 shows that employment orders subdivide into three groups: (1) movement, (2) disposition and (3) clearing. For each type of movement there exists a pair of possible orders. These pairs permit successive movement legs on an overall movement route without invoking a phase 1 status (reforming) at the beginning of each continuation leg.

Disposition employments define the basic defensive and cover positioning for battle units, and each disposition implies (asks for): (1) a basic vertical positioning either on or above the terrain surface; (2) a basic cover mode; and, (3) a basic formation (distribution) of battle units. The method for processing orders

Employment Sequence		Statuses By Phase			
No.	Sequence	Phase I	Phase 2	Phase 3	Phase 4
1.	March to and Halt at	Regrouping	Marching	-	Halted
2.	Continue marching to	-	Marching	-	Halted
3.	Advance to and Halt at	Regrouping	Advancing	-	Halted
4.	Continue Advancing to	-	Advancing	-	Halted
5.	Attack to and Halt at	Regrouping	Attacking	-	Halted
6.	Continue Attacking to	-	Attacking	-	Halted
7.	Withdraw to and Halt at	Regrouping	Withdrawing	-	Halted
8.	Continue Withdrawing to	-	Withdrawing	-	Halted
9.	Take off and Fly to the Point	Regrouping	Flying	-	Halted
10.	Continue Flying to	-	Flying	-	Halted
11.	Clear Buildings from the Line to	Regrouping	Clearing	-	Halted
12.	Clear Buildings along the Line to	Regrouping	Clearing	-	Halted
13.	Take Cover at	-	-	Taking Cover	Defending
14.	Dig in at	-	-	Digging in	Prepared
15.	Fortify the Building Positions at	-	-	Fortifying	Entrenched
16.	Cover from the Building Positions at	-	-	Locating	Covering
17.	Overlook from the Building Postions at	-	-	Locating	Overlooking
18.	Occupy the Building Positions at	-	-	Locating	Occupying
19.	Halt	-	-	-	Halted
20.		-	-	-	Immobilized
21.		-	-	-	Dead

Figure 10. Unit Employment Orders

when attempting to apply the disposition to a battle unit does three things: (1) examines the asked for conditions and resolves any anomalous combinations to the nearest reasonable equivalent disposition; (2) examines the terrain and terrain features in the disposition area and selects the asked for condition if available or the closest alternative condition; and, (3) sets the final disposition conditions (cover, location, vertical position) of the battle unit.

Clearing employments are mechanized as a special interpretation of movement with two types of clearing operations available: phase line to phase line (e.g., block area clearing) and on line (e.g., threat force doctrine of second echelon clearing along a penetration route).

Disposition orders are the measures by which players make specific tactical usage of structures and built-up area features for disposition of units. A disposition order implies (1) a basic vertical positioning either on or above the train surface (in structures); (2) a basic cover position; and, (3) a basic formation (distribution) of battle units. The players' input disposition order asks for a disposition; this request will be honored, provided the local terrain conditions permit. If the terrain does not permit exact compliance - e.g., the necessary structures or structure heights are not available within the designated employment area - then, an alternate, nearest equivalent disposition is chosen.

The basic dispositions and implied vertical positions are:

Basic Disposition	Vertical Positioning
Take Cover	Ground level
Dig In	Ground level
Fortify	Ground level or first floor structure level
Cover	Second/third floor structure level
Overlook	Highest available structure level
Occupy	Distributed on all structure levels.

The available cover positions are:

(1) In the open area
(2) In the street (or road)
(3) Among the available structures
(4) In the available structures
(5) Among the sparsest structures
(6) In the sparsest structures
(7) Among the densest structures
(8) In the densest structures
(9) In the tallest structures
(10) In the strongest structures

The formations used are distributions of battle units with a defined command area of some specified shape and size. There are 17 basic distributions of units available; these formations and distributions are common to all employment orders.

b. Fire Orders

All support fire requests are initiated through a fire order, with two basic types of requests available: specific, player targeted, fire missions and on-call fire missions for which targeting is supplied by a forward observer (F.O.). Actually, on-call mission targeting is supplied by the intelligence function of the program model. That model maintains an F.O. contact list and when level of contact is sufficient (based on intervisibility and length of time of contact), a mission request is initiated for a designated suppor fire unit to fire an appropriate target-matching mission. The mission request is honored, if firing units are available, by selecting from among a set of standing fire orders designating the available fire missions that unit can fire.

Fire orders depend on supporting input data of two kinds: the weapon data (and battle unit designation of weapons) and mission data. All potential mission types must be prespecified by input data, and these missions may define both artillery support fire and CAS.

In general, the fire order permits specific definition of fire missions in several ways:

- Start time and termination criterion may be specified.
- The firing unit is designated; this, through the battle unit input data and weapons data defines a support firing unit with a single weapon with up to four types of ammunition available.
- A mission type designation specifies a particular input of mission type data, giving, among other things, the specific ammunition mix.
- Point or area fire may be specified.
- Spread and depth of pattern may be specified.

c. Conditional (IF) Orders

Conditional orders provide a basic logical "if" capability in order sequences for units. The existence of an IF order in the sequence causes a test to be made for the existence of a particular condition; if that condition exists (is true) a specified, alternate sequence of orders will be adopted. If the condition does not exist, the original sequence of orders will be continued.

The conditional orders provide for 21 possible conditional test based on various conditions such as time, force ratio between commands, rate of advance, surviving strength, separation distance and status.

d. Instructions

The remainder of the order set comprises a block of available orders (instructions) which cause units to adopt specific conditions or control other orders. In summary, these instructions are:

- FRAME - defines the order which a unit is to undertake beginning the next time interval (simulation time step)
- STOP - initiates the end of the simulation (game).
- TIME - starts a "timer" on a specified unit.
- RECORD - causes several specified values to be recorded on a particular unit.
- CHOOSE - directs a unit to choose between two possible sequences of orders according to a specified probability.
- ENVIRE - sets a temporary environmental condition in a specified area for a specified time and (possibly) for a specified type of unit and/or status.

- GROUP - causes all units of a command to move at the rate of the slowest element.
- CLOSE - causes a unit to deviate from the present line of movement, close on a hostile firing unit, then move to its original destination.
- NO CLOSE - terminates a CLOSE order.
- GOTO - causes an unconditional jump to a specified order.
- MINDAM - directs a unit to fire on a target only if a minimum level of damage (kill) can be expected.
- HLDFIR - directs a unit to hold fire.
- NRMFIR - terminates an HLDFIR order.
- CALL - directs the unit to execute a subroutine of orders, then return to the original sequence of orders; i.e., directs execution of a "standing sequence of orders."
- RETURN - directs the program to return to an original sequence of orders following a CALL order.
- GOSUB - directs the program to execute a special FORTRAN subroutine.
- CHANGE - changes the order sequencing of a CU by inserting a new order.
- MOUNT/CARRY - directs a unit to ride aboard (mount on) a transporting unit (and adopt the transporting units order sequence).
- DISMNT - terminates a MOUNT order.

4. Combat Model Functions

The combat model comprises five major submodels, each submodel corresponds to a major subroutine within the MOBACS simulation. The five major submodels are the Orders Processing Submodel, the Search and Contact Submodel, the Target Acquisition Submodel, the Fire Event Submodel, and the Unit Status Submodel. Each of these submodels is described below.

a. Orders Processing Submodel

The Orders Processing Submodel has five primary functions, each of which is described as follows:

(1) Order Initiation and Sequencing. The submodel initiates all orders for units in the sequence prescribed by the player. If the input order is an instruction, zero execution time is implied; therefore, the submodel immediately sets the ordered condition. When the order is a conditional (IF) order, a test of the ordered condition is made and the submodel immediately goes to the next or continued order on the basis of the test. Fire orders and employment orders require variable periods of time for execution; thus, the submodel monitors each initiated employment or fire order for completion. Upon completion of an employment or fire order, the next sequential order is chosen.

The submodel initiates orders in a subordinate command mode. That is, input orders may be addressed to command units (or maneuver control units) only. The submodel initiates an order by "issuing" it to each battle unit (unit of resolution) reporting to that command. The ordered conditions are individually set for each battle unit.

(2) Battle Unit Disposition. If the input order being initiated is a disposition order, the submodel selects the battle unit positions for the closest approximation to the disposition ordered. The submodel does this by:

- Selecting a number of trial positions within the area of disposition.
- Accessing the terrain model for each trial position to determine the terrain feature conditions about each position.
- Comparing the terrain features of each trial point to the disposition requirements.
- Selecting the closest matching subset of points as battle unit positions.

Selected unit positions are held until either a movement order or another disposition order is received.

(3) Battle Unit Condition. In each interval of processing time (time step) the local condition of a battle unit is recalculated provided the unit has moved since the last time period. The local condition of a battle unit is the terrain

and terrain feature data (from the terrain data model) for the immediate battle unit position. Thus, each battle unit carries a description of its immediate terrain environment with it at all times.

(4) *Battle Unit No-Fire Speed.* The average forward no fire speed is calculated in each time interval for each battle unit operating under a movement order. No-fire speed is computed as a function of unit status and the forward terrain environment on its movement path. The submodel also checks the forward movement path for possible barriers and speed restriction areas (environment areas).

(5) Support Fire Event Initiation. The submodel checks for possible support fire events during the time interval in three ways. First, it checks for initiation of any (new) scheduled/preplanned fire orders. If there are any, the submodel initiates a fire event on the fire event list for this time period for each battle unit firing the mission. Second, the submodel checks for any standing orders to support on-call fire requests. The submodel checks for any forward observer (units) requests for on-call mission. Subject to the availability of fire units the submodel assigns a fire mission by initiating a fire event on the fire event list of this time period for each battle unit firing the mission. Third, the submodel checks for completion of any previously initiated fire order.

b. Search and Contact Submodel

A contact list of active contacts is maintained by this submodel. Contacts are made and maintained by the first level of command (command unit or maneuver control unit) immediately above battle units, contacts are established on the basis of intervisibility and detection, with detection itself conditioned on target type, visibility conditions, and target disclosure. A contact level is calculated on maintained contacts; contact level is a function of the strength of contact and time the contact is maintained. Up to five contacts per unit are maintained and are ordered on the basis of contact level. Targets of contacts are comparable command units or maneuver control units.

An F.O. unit also maintains a list of active contacts; these are established and ordered on the list in the same way as for command units. The first listed of the ordered contacts has the highest contact level value; and, provided the value is above a given threshold value (specified by input), that first contact entry for an F.O. unit serves as a triggering request for on-call fire support.

The Support Fire Event Initiation function of the Orders Processing Submodel above actually searches the F.O. contact list for possible contact level values above the threshold. On finding a qualifying value the Support Fire Event Initiation function examines the target class of the contact and matches that to an available fire order mission.

Contact list entries are reported to the players as intelligence. The original design of the Search and Contact Submodel included a communications delay function which age-dated the output intelligence report. However, that delay function was predicated on communication delays caused by structured area interruption of transmission, and no sources of empirical data could be located to evaluate the model. Therefore, the communications delay function has been disabled in the programs versions of the model.

c. Target Acquisition Submodel

The Target Acquisition Submodel provides three primary functions. First, it provides a direct battle unit to battle unit contact. Second, it makes target priority selections for firing for each battle unit and enters direct contact fire events on the fire event list. Third, it completes the initial support fire event entries on the fire event list. The overall purpose of the target Acquisition Submodel is generation of the full fire event list. It should be noted that the fire event list is completely regenerated in each calculation time step.

The contact list (Search and Contact Submodel, above) is used to limit the targeting search by battle units. A battle unit will search for targets only if its immediate superior unit (command unit or maneuver control unit) has an established contact. Also, a battle unit will search for targets only among the hostile battle units defined by the superior unit's contacts.

In selecting a target, a battle unit uses several criteria. Among these are:

- Target must be within minimum and maximum engagement range. These limits may be defined as weapon range limits, or as player defined tactical fire doctrine through input data.
- A battle unit may be ordered to hold fire unless a minimum expected level of damage can be obtained.
- Targets will always be selected on a target priority basis. That priority basis is maximum threat reduction.

The firing battle unit together with its selected target battle unit is entered on the fire event list.

The Target Acquisition Submodel also completes the initial support fire events. It does this by establishing the mission impact area on the basis of mission type, aim point, pattern, and aim error; then, it searches that area for any battle units contained within it. Any battle units found are entered as target units for the mission on the fire event list.

d. Fire Event Submodel.

The Fire Event Submodel processes all fire events on the fire event list, aggregates the resultant attritions, and computes immobilization and suppression factors. When the Fire Event Submodel is reached in the Combat Model processing sequence, all necessary data and conditons have been established, either by previous submodels or by input data.

The event-by-event processing gives (potentially) partial attritions on units - e.g., a unit may have been multiply targeted. These partial attrition are aggregated for each target fired on and the resultant fraction kill, suppression or immobilization is calculated. The partial attritions on units are, in themselves, aggregations of elemental attritions caused by the combinations of multiple firer weapons on multiple target elements in the target unit.

A firing unit may have up to four weapons defined, each with specific weapon characteristics. Among the defined characteristics is the weapon's ability to attrit each of four elemental target classes, personnel, wheeled vehicles/ light armor, heavy armor, and aircraft. For targets protected by structures, a modified attrition is calculated, based on the weapon's (round) capability to penetrate the structure and the residual lethality, given penetration.

In a similar fashion, each elemental target class is defined as having a basic vulnerability as a personnel target, a wheeled vehicle/light armor target, a heavy armor target or an aircraft target. Any target battle unit may have combinations of vulnerability classes. Therefore, a weapon with personnel attrition capability will attrit the personnel element of a target unit; a wapon with light armor attrition capability will attrit the light armor element of a target unit. Elemental

attritions are calculated for each weapon attrition class against each target element vulnerability class. These elemental attritions are summed for each firer weapon; these sums are then aggregated for each firer weapon to produce the partial attrition of a firing event.

The calculation of elemental attrition depends on the basic type of fire and the basic disposition of the target. Nine fundamental attrition cases are formulated for this calculation, and they come about as indicated below:

Basic Fire Type	Basic Target Disposition		
	In the open	Among Structures	In Structures
Direct, Point Effects Fire	1	4	7
Direct, Area Effects Fire	2	5	8
Indirect, Area Effects Fire	3	6	9

Suppression calculations are based on formulations, taken from a small unit combat simulation, which expresses suppression as a function of the aggregate incoming lethality. These are relatively simple expressions; however, they have the advantage of having been subjected previously to sensitivity analyses. Thus, their behavior function is reasonably well-known.

e. Unit Status Submodel. This submodel updates the status of each unit at the end of each time step of calculation. The primary updates occur for position (movement) and activity completion.

C. MOBACS SIMULATION DEVELOPMENT

1. Simulation Structure

A pictorial overview of the MOBACS simulation is presented in Figure 11. The overall simulation is divided into three basic program overlays as indicated by dashed lines in the figure, and these three overlays are referred to as LINK 1, LINK 2, and LINK 3. The divisioning into three overlays is partly due to requirements on computer core space, but it is also functionally efficient on the basis of the primary purpose of each link: LINK 1 is the initial game data input processor; LINK 2 is the basic combat simulation processor; and LINK 3 is the cyclic data input processor.

a. LINK 1 Structure

The LINK 1 program controls the execution of ten major subroutines; each of which processes a specific type of data input supplied by the user. Each subroutine also does some editing and prints diagnostic messages when errors are found. The user also has the option of listing the (processed) input data for further manual checking. When all the input cards have been processed (and no input errors found) the data for starting the first game are written to a tape or disc file for use by LINK 2.

In addition to running the basic game defined by the user, the model also contains (via additional user inputs) an automatic parameter variation feature. This enables the user to specify that the game is to be replayed, but with new values for one or more of the items of data. A number of replays of the game is permitted, each with a new set of values. This is called "sampling" of the game's performance to provide comparative analysis of parameter effects. In the current version, due to the complications that arise when orders are changed or added, the automatic parametric analysis feature cannot be utilized fully when using LINK 3 (an optional program overlay).

As shown in the LINK 1 box of Figure 11, if the user has provided additional data for this feature, these data are also edited and processed and merged with the unaltered data. The modified data set then forms the starting

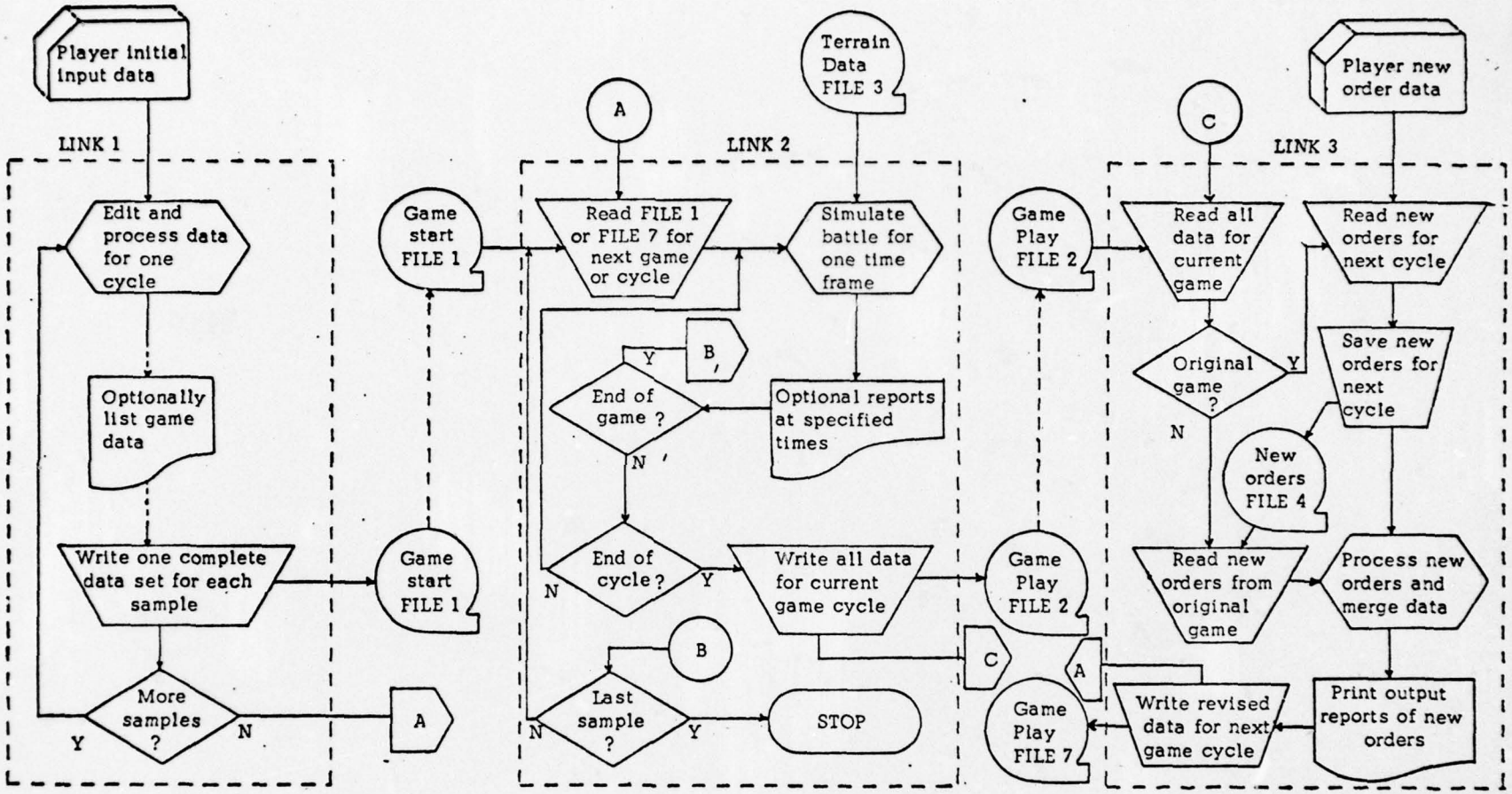


Figure 11. Overview of the MOBACS Simulation

data for another (but similar) game and is also written to FILE 1 for use by LINK 2. This process is repeated automatically until the user input for new samples has been exhausted. The present version permits as many as ten samples for each basic game data set.

b. LINK 2 Structure

The LINK 2 program controls the execution of seven major subroutines that comprise the simulation of combat. To begin, the first record is read from FILE 1 to load the starting game data into the storage arrays and program variables. Then a series of subroutines simulates battle by considering environments, local terrain features, processing orders, searching for targets, selecting and firing at targets, assessing target damage, and updating battle unit data arrays.

The above sequence of steps for combat is simulated over a period of time called a time "frame", i.e., the basic "time-stepped" computation interval for MOBACS. This feature computes assessments at the end of each fixed, and equal, time period (a user input).

There are various types of reports that can be produced during the simulated battle. The user specifies how frequently each of these is to be printed, and at the end of each frame the program checks to see if one or more of these optional reports is due.

A check is then made to see if the game has ended. This can occur through a STOP order being encountered, or by encountering a predetermined game-end condition. This leads to a check for parameter variations. If there are any input parameter variations, the program restarts by reading FILE 1 again for the next record block containing all data necessary to start another game (identical to the first game except for the varied parameters).

If it is not the end of a game, another check is made for "end of cycle". The cycle is a second basic unit of time in MOBACS; it is defined by a specified number of time frames. The purpose of a cycle is to permit the

user to interrupt the simulation and modify existing orders or add new orders. Such modified or new order inputs are processed in LINK 3 (described more fully later). If the user does not wish to implement the cyclic feature, the cycle time can be set to a very large number of frames and LINK 3 will not be required.

If it is not the end of a cycle, an internal game "clock" (representing elapsed combat time) is augmented by one time frame and another frame of battle is simulated. When the end of a cycle is reached, all data from the current game cycle is written to FILE 2 for use by LINK 3.

c. LINK 3 Structure

The LINK 3 program controls the execution of one major subroutine that permits the user to alter existing orders or input new orders at discrete time intervals (cycles). To begin, FILE 2 is read to load complete game play data into the storage arrays and program variables.

A check is then made to determine whether this is the original game, or a parametric variation. If it is the original game, the user input cards must be read in, supplying the new order data for the next cycle. For subsequent parametric runs, these inputs must be stored in card image format and are stored on FILE 4. If the previous check revealed that this is a parametric run, the next step is to read FILE 4 to obtain the new and modified orders for the next cycle.

In either case, the program must then process the input as is done in LINK 1. The same editing is done and a listing is provided of the processed user inputs. As in LINK 1, if there are no user input errors, the complete (revised) data set for continuing the game another cycle is written to FILE 7 for use by LINK 2.

Program LINK 2 then senses that it should read FILE 7 and continues the game as in previous cycles. Programs LINK 2 and LINK 3 are thus alternately employed until the game ends. The LINK 3 user input also specifies the length of the next cycle, which permits the game to run with either more or fewer interruptions, depending upon the necessity for changing orders.

MOBACS has been run mainly in the "batch" mode; however, other modes have been examined. One run was made with the 3 program links on disc storage with control exercised via JCL cards. This mode simulated a "remote batch" mode of operation emulating user operation of MOBACS via a terminal. It was concluded that it would be prohibitive in cost to run the game interactively from a terminal.

d. Program LINK 1

The general flow diagram of LINK 1 is shown in Figure 12. The program consists of ten major subroutines (shown as hexagons), 11 integer function programs, 7 small subroutines (used for printing) and 3 inline functions that are part of the standard FORTRAN software package of most computer installations. The primary function of LINK 1 is to read in and process the user input cards, check for errors and (at user option) print out these data inputs in a format that enables the user to easily check the game set-up and instructions. Considerable editing is done to check for various types of errors and appropriate messages are printed out as diagnostic aids.

With the exception of the first subroutine, all subroutines read in a variable number of cards of a single specific format (card Forms 01-12).* The number of cards of each type is determined by the number it takes to describe the game and is limited only by the dimension of the array size allocated in the coding to each element of that data set. The following table lists the major subroutines and their function.

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*A detailed description of specific input data formats appears in Volume III, "MOBACS User's Manual".

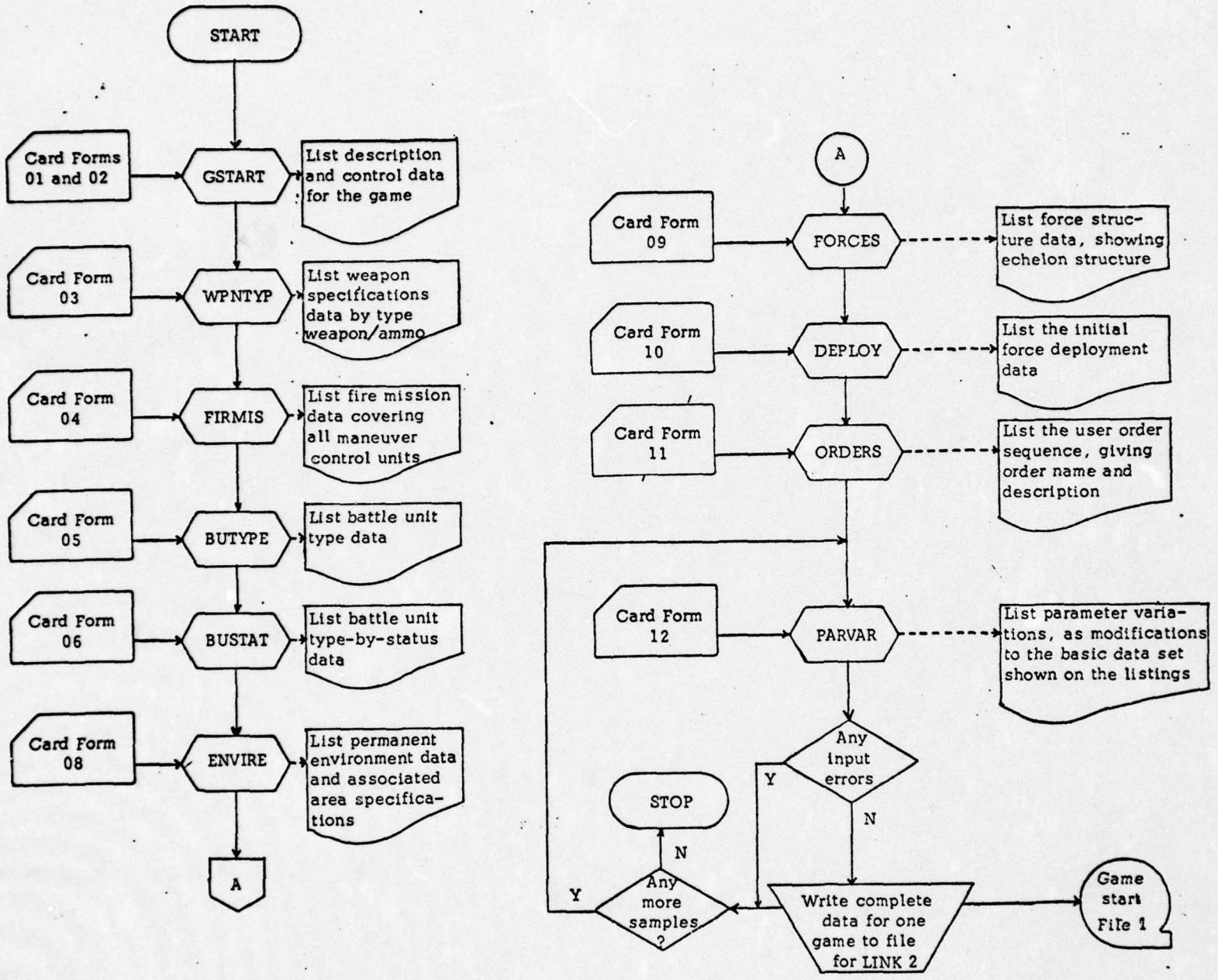


Figure 12. LINK 1 Flow Diagram

Subroutine	Function
GSTART	Processes two cards: one containing an alphameric description of the game being played; and the other containing game control information, including the frequency and type of reports printed during the simulation.
WPNTYP	Processes up to 60 type weapon data cards. One card is required for each weapon type, any of which can be assigned to both Red and Blue battle units.
FIRMIS	Processes up to 50 fire mission type data cards, each of which specifies the munition aspects of a support fire mission. These data augment the information required on a FIRE order card, and may be referenced by both Red and Blue units.
BUTYPE	Processes up to 15 Red and 15 Blue battle unit type data cards, providing information on the unit characteristics. Only one card is required for each type unit, even though several units of a given type may be requested in the force structure listing.
BUSTAT	Processes 20 battle unit type-by-status data cards for each unit type specified for BUTYPE. These data permit describing battle unit characteristics that depend on unit activity, defined by 20 statuses.
ENVIRE	Processes up to 50 permanent environment data cards, defining certain characteristics in specific areas of the game board.
FORCES	Processes up to 50 force structure data cards for each side, giving the command reporting structure as they are organized for combat. Each Red and Blue force can have a combined total of up to 200 command and battle units.
DEPLOY	Processes up to 200 initial deployment data cards (combined Red and Blue), defining the disposition of command units at the start of the simulation.
ORDERS	Processes up to 300 initial order cards for command units (combined Red and Blue), prespecifying sequences of employments and related actions (e.g., certain of their tactics and control of their fire).
PARVAR	Processes parameter variation data cards, enabling the user to automatically replay the same basic game up to 10 times but with new values for one or more items of data (except orders and force structure).

When the data cards for one sample (including the original basic game sample) are read in and processed, a check is made for errors. If there were no user card input errors, a complete data set for one game is written to FILE 1 (tape or disc file) for use by LINK 2. If more samples are to be run using the same basic data, the PARVAR subroutine is reentered to process and error-check each set. Each of these become another game and is written (if no errors) as another record on FILE 1. When there are no more parameter variations for a given basic game, the LINK 1 program terminates execution.

e. Program LINK 2

The general flow diagram of LINK 2 is shown in Figure 13. The program consists of seven major subroutines (shown as hexagons) in addition to 19 other subroutines, one real function program, and ten additional library and inline function programs that are part of the standard FORTRAN software package at most computer installations.

The LINK 2 program is the heart of the MOBACS game. It simulates combat through a series of subroutines that consider troop deployment, environment, unit movement, terrain, executing command orders, searching for targets, selecting and firing at targets, assessing target damage, and updating unit data arrays.

The first step in LINK 2 is to read the starting play data from FILE 1. Various housekeeping instructions are performed and subroutine SETUP is entered for deploying the battle units to coordinate positions according to the formation code (pattern) specified from LINK 1 inputs. This subroutine then performs additional housekeeping chores. The second step in LINK 2 is a check, made each time frame, to see if any reports are due to be printed. There are four types of reports that can be produced, and the user has specified how frequently each of these is to be printed.

The third step in LINK 2 is Subroutine DYNENV, entered once each frame for the purpose of removing dynamic environments that have expired. Dy-

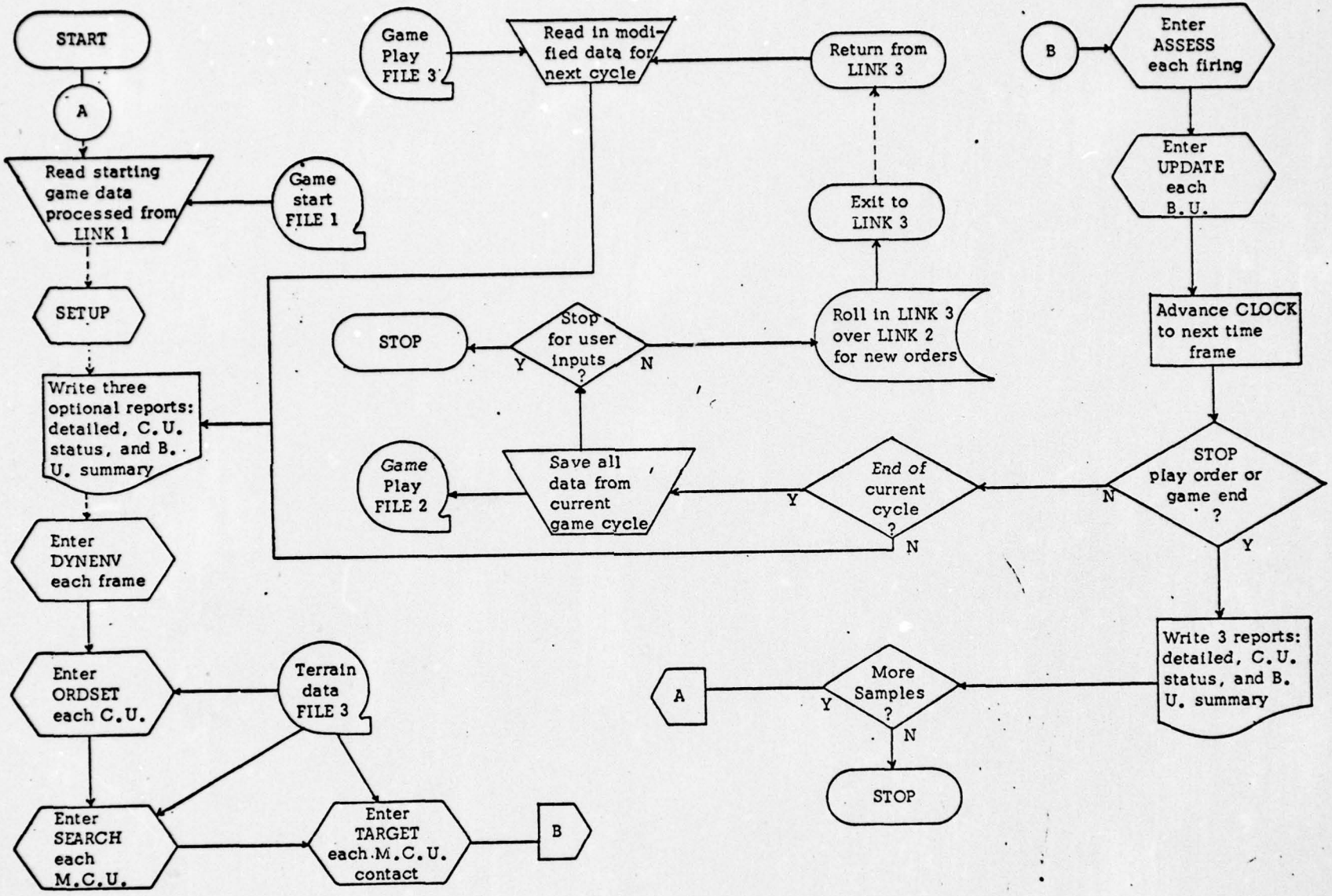


Figure 13. LINK 2 Flow Diagram

namic environments are order-created and differ from the user specified permanent environments which exist during the entire game. Dynamic environments exist only over some prespecified period of time, based perhaps on some contingency. Thus, at the end of the specified period, the characteristics (and subsequent effects) of that environment must be removed from further consideration in the succeeding time frames.

The fourth step in LINK 2 is the processing of units throughout the actual combat simulation subroutines of ORDSET, SEARCH, TARGET, ASSESS and UPDATE. Each of these subroutines is described briefly below.

The ORDSET subroutine is the longest and most complicated program in MOBACS. It is akin to a central nervous system of the simulation, with the player-prepared orders acting as the "brain" controlling the activity and behavior of the game being played. In essence, ORDSET processes the order(s) to be executed in the current time frame for one command. It is entered once each frame for each command unit that has an order. During the processing it then "issues" that order to all subordinate command and/or battle units. Since each order carries the necessary information to define the next order in sequence, the player may formulate multiple orders to be executed by a command in a single frame.

The SEARCH subroutine is responsible for updating and/or adding enemy units to the "contact list", a list of potential targets. The Red and Blue sides have separate contact lists and they may contain up to 50 friendly units, each having up to 5 enemy units as contacts. The subroutine is entered once each frame for each MCU, and the search for enemy units is also restricted to MCUs. Establishing a contact depends on intervisibility and detection between hypothetical units at the centers of gravity of the two MCUs. If the probability of contact exceeds an input threshhold value, it is added to the contact list, along with the time of contact. Only the 5 enemy units having the highest contact probability are retained; and if the MCU has a forward observer (FO) as one of its subordinate BUs, the FO is "given" information regarding the enemy unit having the highest contact probability. Updating units already on

the list consists of reassessing the probability of contact by permitting this probability to increase with time on the contact list.

The TARGET subroutine completes the construction of the "fire event list" for the current time frame. There is only one fire event list and it may contain up to 200 firing events (combined Red and Blue). At the beginning of each time frame, the fire event list is cleared; and if there are any orders specifying scheduled fire, ORDSET enters the appropriate information on this list. Then for each of these entries, TARGET locates all enemy BU within the firing pattern area specified in the order, and makes a separate entry for each one. Another function of TARGET is to examine all subordinate BU to BU pairings of the MCU to MCU contacts established by SEARCH. Establishing a BU to BU contact here follows the same logic as in the SEARCH subroutine, except that the probability of intervisibility and detection are computed using the actual BU coordinates. For each of the BU pairings that exceed the contact probability threshhold, TARGET calculates the potential reduction of target (enemy BU) threat capability that would result from firing for one frame interval. Then for each MCU pairing on the contact list, the subordinate BU pairing that resulted in the highest potential threat reduction (above a threshhold value) is entered on the fire event list.

The ASSESS subroutine computes the damage resulting from each fire event appearing on the fire event list. Since a battle unit may receive fire from more than one enemy unit, results from multiple fires are accumulated against a target BU, which is then processed in a combined attrition/suppression model to determine the actual fractions of kill and suppression. The calculations are more complicated than the usual assessment models due to the numerous combinations of the various factors involved. First of all, there is a separate processing branch for units executing a "clearing" order and for each of the 9 classes of battle units (considered as a target). Then within each of the ten processing branches, there are 9 attrition equations to be considered. These arise from the combinations of 3 types of fire (direct with point effects,

direct with area effects, indirect with area effects) and 3 categories of target exposure (open, among structures, within structures).

The UPDATE subroutine is responsible for updating the various unit records resulting from the events of the current time frame. This includes such things as BU position, phase and status changes, and command unit center of gravity. UPDATE also initializes conditions in preparation for recording the events of the next time frame.

Returning to Figure 13, the last step in LINK 2 involves the repetition logic. With the processing of all command and battle units for the events in a given time frame completed, the game "clock" is advanced one time (frame) interval before returning to process the next frame. This process of acting on orders, detection, targeting and selection, firing and damage assessment, and updating unit arrays is repeated throughout the game frame by frame.

If an order is encountered to stop the play, or a game-end condition has been realized, 3 output reports are automatically printed. Then if there are more samples (parameter viariations) to run, play is again initialized (via SETUP) and another game is played. At the end of the last sample, MOBACS is automatically terminated. The remainder of Figure 13 is discussed in Section 3.

f. *Program LINK 3*

The general flow diagram of LINK 3 is shown in Figure 14. The program consists of one major subroutine (ORDER3) in addition to ten integer function programs, 3 small subroutines (used for printing), and some additional function programs that are part of the standard FORTRAN software package of most computer installations. The prime task of LINK 3 is to periodically read in and process new "order" cards, check for errors, merge them with the existing order set, and print out these data inputs in a format that enables the user to check for logical errors. Considerable editing is done to check for various types of errors and appropriate messages are printed as diagnostic aids.

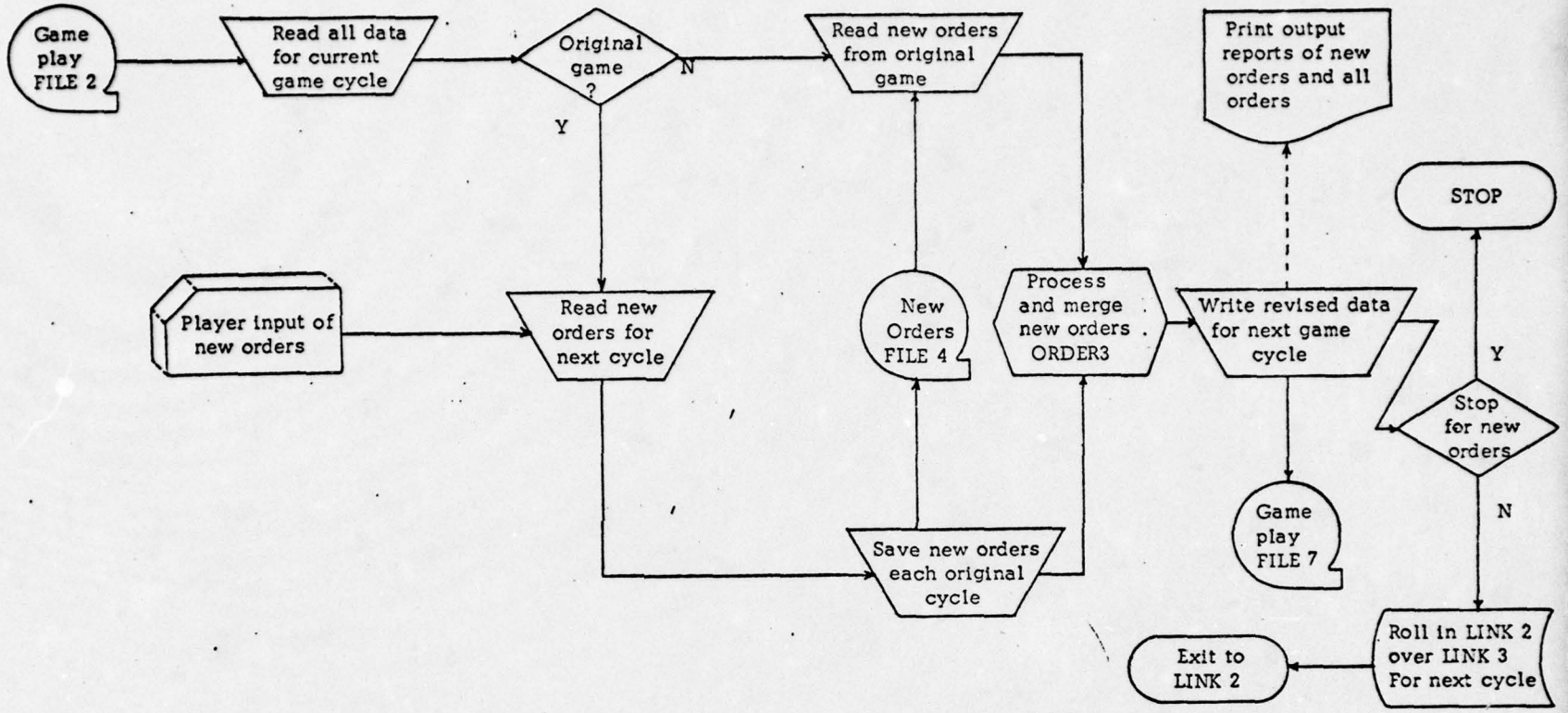


Figure 14. LINK 3 Flow Diagram

When LINK 3 is entered, the first operation is to read FILE 2 (from LINK 2) to load the complete game play data into the various storage arrays and program variables. A check is then made to determine whether this is the original basic game, or a parametric variation (subsequent sample). If it is the original game, user input cards must be read in to provide new order data for the next cycle. Card images of these inputs are then stored on FILE 4 for use by subsequent parametric games. If the previous check revealed that a "sample" game is in process, then the next step would be to retrieve these card images from FILE 4 rather than expect them as card input.

In either case, the ORDER3 subroutine processes the input orders in a manner similar to that done in LINK 1 by the ORDERS subroutine. The ORDER 3 subroutine is patterned after the ORDERS subroutine of LINK 1. However, it is somewhat longer and more complex. The reason for this is that it must be able to detect a replacement order (or one modifying an existing order) from a new (additional) order. All the orders available to the ORDERS subroutine can be used as input to ORDER3 and these are discussed briefly in Section 2 and more fully in Volume III.

As in LINK 1, after processing, the user is provided a listing of the input data; and if there are no user input errors, a complete data set (revised from FILE 2) for continuing the game another cycle is written to FILE 7 for use by LINK 2. Logic control is then passed to LINK 2, entering the program at the same position that is done when beginning any new time frame. This alternating between LINKS 2 and 3 continues each cycle until the game ends.

2. Input Data Organization

a. General Description

All MOBACS input is accomplished through 11 basic input data card forms (data formats); some input data card forms have multiple usages - e.g., Orders input data forms, which have 25 variations of the same basic format. The 11 basic types of data input forms can be grouped according to general usage for a game: (1) Basic Input Data which may be prepared well

in advance of a game (or come from a data bank); (2) Special Situation Data, which is game-unique initial input data; and (3) Game Play Data. In the Force Operations Level Game (cyclic simulation version), Game Play Data is input during (throughout) game play. In the Unit Operations Level Game (closed simulation version), Game Play Data is input as initial input data. The following table indicates the general blocking of data.

Basic Input Data Card Form	Basic Input Data	Special Situation Data	Game Play Data	Maximum Total Input Cards[2]
1. Game Description Card		X		1
2. Game Control Data Card		X		1
3. Weapon Type Data	X	(1)		60
4. Indirect Fire Mission Data	X	(1)		50
5. Battle Unit Type Data	X	(1)		30
6. Battle Unit Type vs. Status Data	X	(1)		600
7. (Not Used)				
8. Permanent Environment Data		X		50
9. Force Structure Data		X		100
10. Initial Deployment Data		X		200
11. Orders Input Data			X	300/800[3]
12. Parametric Variation Data		X		430/sample

(1) Selected special situation inputs may be required, depending on force structure.
(2) Generally, any number required up to this maximum number.
(3) 300 for Unit Operations Game; 800 for Force Operations Game.

b. Basic Input Data Cards

The basic input data consists of data describing the basic force elements - the building blocks of battle units and weaponry - for both the friendly forces and the threat forces. The necessary data cards are described briefly below; an illustration of the array of card data for Card Forms 5 and 6 is shown in Figure 15.

BU DATA WORKSHEET

STATUS

		STD	RG (Regrouping)	MA (Marching)	AD (Advancing)	AT (Attacking)	WD (Withdrawing)	FL (Flying)	CL (Clearing)	TC (Taking cover)	DI (Digging in)	FF (Fortifying	LC (Locating)	HT (Halted)	DF (Defending)	PP (Prepared)	EN (Entrenched)	CV (Covering)	OV (Overlooking)	OC (Occupying)	IM (Immobilized)	DE (Dead - no user input)
	BYTYPE DATA																					
	Unit Side (R = red, B = blue)																					
	BU class																					
	Name of BU type																					
	Type of fire (DIRECT, SUPPORT, EITHER)																					
B01	Name of weapon type 1																					
B02	Name of weapon type 2																					
B03	Name of weapon type 3																					
B04	Name of weapon type 4																					
B05	Unit strength (combat value)																					
B06	Critical value for unit (% of value > 0)																					
B07	Max slope of unit mobility (%)																					
B08	Volume of (detectable) unit element (m^3)																					
B09	Time required to regroup (min)																					
B10	Time required to take cover (min)																					
B11	Time required to dig in (min)																					
B12	Time required to fortify (min)																					
B13	Time required to locate (min)																					
B14	Time required to search standard structure (min)																					
	BUSTAT DATA																					
	Name of BU type		same as BUTYPE DATA entry																			
	Applicable BU status		RG	MA	AD	AT	WD	FL	CL	TC	DI	FF	LC	HT	DF	PP	EN	CV	OV	OC	IM	DE
S01	Max speed (m/min)																				0	
S02	Fire effectiveness ratio, weapon 1																					
S03	Fire effectiveness ratio, weapon 2																					
S04	Fire effectiveness ratio, weapon 3																					
S05	Fire effectiveness ratio, weapon 4																					
S06	Unit personnel vulnerability ratio (to norm)																					
S07	Unit lt. armor vulnerability ratio (to norm)																					
S08	Unit hvy. armor vulnerability ratio (to norm)																					
S09	Unit aircraft vulnerability ratio (to norm)																					
S10	Unit dispersion area (m^2)																					
S11	Unit exposure factor (% of "in the open")																					
S12	Eye-level height above surface or story (m)																					

Shaded areas indicate required variable data entries.

*Each named weapon must have supporting WPNTYP data for that weapon name.

Figure 15. Display of Battle Unit Data Requirements

Weapon Type Data (Card Form 3). One card is required for each unique weapon type named in both the friendly (Blue) and threat (Red) Battle Unit Type Data (see Figure 15). Each weapon type requires a unique 4-character alphanumeric name or designation. Names or designations may, but need not, distinguish between Red and Blue weapons. When a unit has a single, principal weapon (e.g., a 105 artillery battery), each weapon type is interpreted as a unique weapon/ammunition combination - for example 105 with HE or 105 with AP. In such cases, a card is prepared for each unique weapon/ammo combination.

Indirect Fire Mission Data (Card Form 4). Each indirect fire mission - i.e., each unique ammo mix and fire rate - for each basic indirect fire weapon type (see above) must have appropriate data entered on an input card; each card will accomodate data for three (separate) fire missions. Note that preparation of data for these cards is cross-linked with Battle Unit Data (unit weapons) and Weapon Type Data (weapon/ammo type).

Battle Unit Type Data (Card Form 5). Battle Unit Type Data is the standard data on a unit which does not vary due to a unit's activity (status). One card is required for each unique type of battle unit in both the friendly force and the threat force; up to 15 battle unit types for each side may be defined in any game. Figure 15 indicates the types of data required. Each named weapon type must be supported by a Weapon Type Data Card (above). Each battle unit type requires a unique 4-character alphanumeric name or designation. Names may, but need not, distinguish between Red and Blue units.

Battle Unit Type vs. Status Data (Card Form 6). Battle Unit Type vs. Status Data is the variable data on a unit which is (may be) different for each type of unit activity (status). One card is required for each combination of battle unit type and status (i.e., 20 cards per battle unit type are required). The array of required cards and type of data entries are illustrated in Figure 15. In that figure, each status column represents one required data card. Note that weapon fire effectiveness ratios are linked - by inference - to the Battle Unit Type Data Card entries and the supporting Weapon Type Data Cards.

c. Special Situation Data

The special situation data consists of that data which describes the particular initial conditons of a specific game. It consists of the (game) Permanent Environment Data, the data describing force structure (as organized for combat), and the initial deployments of those forces.

Permanent Environment Data (Card Form 8). One card is required to define each desired permanent environment area. Each area represents some specific, bounded terrain area on the game board; and, in effect, represents an overlay of conditions on the Game Terrain Data Model features for that area. The special conditons of an environment area are interpreted as to their effects by type and/or status of battle affected, and their effects on any combination of speed, vulnerability, or engagement range.

Force Structure Data (Card Form 9). The force structure data describes the command reporting structure of each (Red and Blue) force as they are task organized for combat. All attachments and combat task groupings (e.g., an infantry battalion with two tank companies and an engineer company) must be reflected by the input Force Structure Data (no changes may be made during the game). Each unit (command, maneuver control or battle) must be defined by its hierarchical position in the command structure. Each data card provides entries for 12 unit entries.

Initial Deployment Data (Card Form 10). The data entries of this card define the initial disposition of command units on the game board in terms of the area boundaries of the command deployment, the positions of subordinate units within that area, and the name of the first order that command is to execute at the beginning of game play. Note that the latter data element, first order name, is in effect the sole data link between pre-game data (Basic Input Data and Special Situation Data) and game play data (Orders). Because of the data link characteristic, one of two proceedures must be adopted: (1) each (every) command unit (CU/MCU) must be uniquely deployed (perhaps in the same position); or, (2) special, and somewhat intricate order writing procedures must

be adopted during the game (in the Order Input Data) to equivalently generate a first order for units (CU/MCU) not deployed initially with an Initial Deployment Data Card. One card is required for each unique deployment.

d. Orders Input Data

Game play input data consists of the aggregated set of orders to be executed by units during the run of the game. Each individual order requires one card of Form 11. An underlying common card format is used for all orders; however, the data entries and positioning of entries on the card is unique for each order. This results in what amounts to 25 variations of Card No. 11 - one for each order (except "envire"). Each order input carries all the data (or references) necessary to execute that order. Each order input form provides space for a 4-character alphameric name or designation. Procedures for writing orders list the order name entry as optional data (except for "envire"). However, it is recommended that a unique name be given each and every order to forestall inadvertent order sequencing errors. Each order type variation of Order Input Data is briefly described below.

Move Order Data (Card Form 11 - "MOVE"). The "move" order constitutes an order to a command unit (CU/MCU) to move its subordinate units (BU's) from the present position to a designated new position. The input card contains the data necessary to define type of movement, formation for movement, and destination of movement. Movement paths composed of multiple straight-line segments require an input card for each straight-line segment of the path. Completion of a move order leaves the command unit (1) in its move formation centered about the destination point and (2) in a halted (undeployed) status.

Disposition Order Data (Card Form 11 - "DISPOS"). The "disposition" order is an order to a command unit (CU/MCU) to deploy its subordinate units (BU's) (1) about its present position, (2) in a defined formation, and (3) with specified (terrain features permitting) cover and protection. Execution of a disposition order leaves the command unit (its subordinate units) in one of the available deployed statuses with the ordered cover and protection.

Clear Order Data (Card Form 11 - "CLEAR"). The "clear" order is an order to a command unit (CU/MCU) to (1) dispose its subordinate units (BU's), (2) move them through an area, and (3) enter, search and clear all structures in the area. The order input provides two basic modes of clearing: (1) phase line to phase line clearing and (2) clearing of street-adjacent areas. Execution of the clearing order leaves the command unit (its subordinate units) either (1) distributed on the second phase line or (2) in the original (beginning) street positions in a halted (undeployed) status.

If Order Data (Card Form 11 - "IF"). The "if" order instructs a command unit to make a specific test of his own or surrounding battle conditions. If the test criterion is not met, the command unit continues with its present orders; if the test criterion is met, the command unit changes to alternate orders. The input card provides for several variations of basic tests on time, force ratio, relative position, and relative condition or status.

Fire Order Data (Card Form 11 - "FIRE"). The "fire" order permits simulating command fire, as opposed to the automatic fire that can occur between opposing units within their immediate vicinity. Provision is made for both scheduled and on-call support fire. Scheduled fire missions are pre-planned (by the players). Thus the scheduling of these fire orders - start time and duration - is known at the time the orders are written. On-call fire missions are "target-of-opportunity", where the start time and type of mission desired depend on when and what kind of target presents itself. This information comes from a forward observer (FO) unit (via the contact list). The program also permits a support fire command to fire both scheduled and on-call fire. That is a command unit may be ordered to fire a definite (intermittant) plan of scheduled fire; and, between scheduled fire missions, be ordered to provide on-call fire as needed. (This requires special order-writing procedures.)

Hold Fire Order Data (Card Form 11 - "HLDFIR"). The "hold fire" order prevents battle units of the specified type (or all types) under a CU from firing (both command and automatic fire) until the order is rescinded (by a NRMFIR order). Since fire support units may be moved and positioned like any other unit, this

order is necessary to prevent their BU from trying to execute any fire orders while the CU (and thus BU) are moving and deploying.

Normal Fire Order Data (Card Form 11 - "NRMFIR"). The "normal fire" order permits battle units of the specified type (or all types) under a CU to resume normal firing (command and/or automatic) until the order is rescinded (by a HLDFIR order).

Minimum Damage Order Data (Card Form 11 - "MINDAM"). The "minimum damage" order prevents battle units of the specified type (or all types) under a CU from automatically engaging an enemy unit unless the damage expected to be inflicted is at least the specified minimum. This order remains in effect until rescinded by another MINDAM order with a different minimum value specified. A value of zero would completely negate the influence of this order.

Mount/Carry Order Data (Card Form 11 - "MOUNT" or "CARRY"). The "mount" order instructs a CU to mount the specified CU and ride until the destination is reached. If the CU is prematurely dismounted, the specified alternative order is taken next. The "carry" order data input instructs a CU to carry the specified CU until it encounters a "dismount" order. If its BUs are killed or immobilized before this occurs, the CU automatically discharges its riders. Both orders must be in effect before a "marrying" of the units can take place (e.g., an APC unit carrying an infantry unit).

Dismount Order Data (Card Form 11 - "DISMNT"). The "dismount" order instructs a CU to discharge its riding CU and "decouple" all memory of the liaison. If its individual BUs are killed or immobilized before this order is encountered, it will discharge riders independently (unless the carrying CU is also moving under a "group" order).

Environment Order Data (Card Form 11 - "ENVIR 1 and ENVIR 2"). The "environment" order is an order that establishes certain local conditions (speed, engagment range, and vulnerability) within a defined area for a specified period of time. This constitutes a dynamic environment, as opposed to the permanent environments

that last for the duration of the game. Two cards are required for input since all the data could not fit on one card. The number of permanent environments plus the number of dynamic environments in effect cannot exceed 50.

Group Order Data (Card Form 11 - "GROUP"). The "group" order causes all moving BU of all types under the CU, not closing with an enemy target, to reduce their speed to that of the slowest BU currently moving. This order remains in effect for one frame only, and must be repeated (via an order loop) if it is desired to continue group speed movement over a protracted period.

Close Order Data (Card Form 11 - "CLOSE"). The "close" order instructs all BU (of the specified type) under the CU to close with the enemy target last engaged (if any) until either the engagement is self-terminated or until ordered otherwise (by a "no close" order).

No Close Order Data (Card Form 11 - "NOCLOS"). The "no close" order rescinds the "close" order and permits the BU (of the specified type) under the CU to automatically engage hostiles, based on the embedded decision logic.

Stop Order Data (Card Form 11 - "STOP"). The "stop" order unconditionally stops the MOBACS simulation game at the end of the current time frame. If there are other games on the Game Start File 1 (see Figure 13), they will continue to be processed in turn.

Time Order Data (Card Form 11 - "TIME"). The "time" order sets an internal "clock" of the CU to the current time augmented by the time interval specified. This clock may then be interrogated by two "if" orders (TIMEUP, MORTIM) and form a basis for a contingent test. The CU clock remains unchanged until a subsequent TIME order is encountered.

Frame Order Data (Card Form 11 - "FRAME"). The "frame" order acts as a flag to signal the end of the order sequence (of the CU) to be executed in the current time frame. The order is executable only in the sense that it stops executing orders (for the CU that frame) and sets the name of the beginning order (for the CU) for the next time frame. It should be noted that to save order space, the

program has been designed to provide an "implied frame" on every order card, which accomplishes the same result. However certain situations, such as the standing fire order sequence, may arise where both methods must be utilized.

Record Order Data (Card Form 11 - "RECORD"). The "record" order records (as of the current time frame) certain tactical data regarding the CU, for possible use in future contingent command decisions (via "if" orders). The order is in effect only the frame in which it is encounterd; but the data remains in storage until another "record" order is encounterd (by the CU), at which time it is updated.

Change Order Data (Card Form 11 - "CHANGE"). The "change" order permits the player to change the order sequencing for the specified command unit, usually not the CU encountering the order. The order is in effect only the frame in which it is encountered.

Call Order Data (Card Form 11 - "CALL"). The "call" order enables the player to utilize (call upon) a pre-specified fixed sequence of orders for execution, and then return to the original order sequence. This capability is necessary for modeling more involved command decisions, such as the standing fire order sequence mentioned previously. The order remains in effect until a "return" order is encountered at the end of the fixed sequence of orders.

Return Order Data (Card Form 11 - "RETURN"). The "return" order enables the player to direct the return (from a fixed sequence of orders) to the original order sequence of the CU. There can be more than one "return" order embedded in the pre-specified fixed sequence, depending on the branching structure within the sequence. The order is in only the frame in which it is encountered.

Go Sub Order Data (Card Form 11 - "GOSUB"). The "go sub" order enables the player to call upon one of five FORTRAN subroutines to be executed during the current time frame. The order permits entering the subroutine with up to four parameter values that may be utilized by the subroutine in its computations. The order is in effect only the frame in which it is encountered.

Go To Order Data (Card Form 11 - "GOTO"). The "go to" order unconditionally directs the CU to jump out of its current sequence of orders and go to the named order for its next instruction (to be executed during the current frame). The order is in effect only the frame in which it is encountered.

Choose Order Data (Card Form 11 - "CHOOSE"). The "choose" order directs the CU to leave (with the specified probability) its current sequence of orders and go to another specified order sequence. This order simulates the effect of unpredictability or command malfunction by possibly ignoring the normal sequence of orders. The order is in effect only the frame in which it is encountered.

e. Parameter Variation Data

The data entries of this card (Card Form 12) enable the user to replay the same basic game many times, but with new values for one or more items of data. This aids the user in locating and evaluating the effect of variation in critical parameters (i.e., any elements of tactics, strategy, capabilities, etc.). Practically all of the data entries on Card Forms 2-8 and 10 may be altered. Since the replay data are read in sequentially, the changes are cumulative from replay to replay unless specifically "undone". There is no underlying limit on the number of replays permitted for a game, but the program has arbitrarily been set at ten.

3. Program Operation

The MOBACS program is at present designed for use on the Control Data Corporation Cyber 73 computer system. It is written in FORTRAN IV and only occasional uses were made of the many special FORTRAN futures available on that computer. However, to conserve core space, the reduced terrain data for each grid square are packed into a single 60-bit word, and unpacked as required during the execution of each game. It is this dependency on word length that makes the program less amenable than usual for conversion to another computer system. Thus any statements involving (or implying) computer software capability is predicated on the use of the Cyber 73 (or others in the series) for running MOBACS.

MOBACS has been run mainly as "batch" jobs. However, one run was made with the three program links (see Figure 11) on disc storage, and control was exercised solely through the use of JCL cards. This simulates "remote batch" operation, similar to running MOBACS from a terminal. It would seem prohibitive in cost to run the game "interactively" from a terminal.

a. Preparation of File 1

For the remainder of this section, it is assumed that the user has filled out all Input Data Card Forms according to the detailed instructions in Volume III. It is further assumed that these have been keypunched and that the user has a card deck (or tape file of card images) at his disposal, along with binary core decks (or tape file) containing the compiled version of the MOBACS program. The user is then ready to run the simulation, and he may submit more than one game in a single job.

The first step is to load the LINK 1 program into core, followed by as many data decks as desired (including any parameter variation cards). The LINK 1 program will read the first game deck, completing the processing of each card before beginning the next. When there are no more cards to be read for that game, the entire input data arrays for one game are written to Game Start File 1 (assuming there were no input errors). Then the next game deck (if any) is read and processed in the same manner. These steps are repeated until no more data cards are encountered. The player then has no more need of LINK 1 and is ready for LINK 2, the basic combat simulation. From this point on, however, there are two basic operational modes of MOBACS.

b. Modes of Operation

The concepts of Unit Operations Level and Force Operations Level Games have previously been discussed. It was mentioned that the Unit operations game is run as a "closed" version of the simulation; and that the Force operations game is run as a "cyclic" version. The choice must be made, of course, before (most of) the input data are prepared. It has already been seen, however, that the mode of operation does not change the way in which data is input to or processed by LINK 1, the initial game data input processor. The player merely makes this choice via the Game Control Data Card (Form 2).

The user operational requirements and implications for the two modes of operation will be considered separately.

c. The Closed Mode

The Unit operations game is easier to run, but may be more difficult insofar as preparing the orders (Card Form 11). This is due to the fact that the closed simulation must be completely prespecified, since the player does not interact with the game during its run. In particular, no changes in the orders are permitted from start to finish. This requires that the user must visualize beforehand the multitude of possible events and propose contingent orders and instructions to avoid unreasonable or meaningless sequences of play.

To operate the game, the first step is to load the LINK 2 program into core and mount the Game Start File 1 and Terrain Data File 3 (unless disc files are being used). Then there is nothing more for the user to do. When the user chooses the closed mode, the LINK 1 program automatically sets the cycle length to a very large number. Thus when the program makes an "end of cycle" check (see Figure 13) after each time frame, the "end" never occurs and the program logic directs the execution flow back to start another time frame.

If an order is encountered to stop play, or a game-end condition occurs, three output reports are printed and a check is made to see if there are any more game data. If so, another record on the Game Start File 1 is read, play is again initialized, and another game is played. At the end of the last game, the computer will automatically terminate the job and print all reports requested during the game(s).

d. The Cyclic Mode

To run a Force operations game, one additional tape must be mounted (unless a disc file is being used) - the Game Play File 2. It is also assumed that the player specified the initial cycle length on the Game Control Data Card (Form 2) as well as the run mode. For the cyclic mode of operation, the program steps involved are precisely the same as those for the closed mode - up to the point where "end of current cycle" is checked (see Figure 13) and

the test was affirmative.

If the end of a cycle has been reached, the complete game play data is saved on Game Play File 2. A check is then made as to whether the player wishes to stop the run in order to add new or modified orders (via LINK 3), or whether the next step is to be accomplished automatically. This choice is specified by the user at the beginning of the original game on Card Form 2. The user would normally stop when running a new game, since uncertainty would exist as to which tree-branching decisions to follow as the frames progress. Assuming this choice, upon restart, the user would then manually enter LINK 3 to process new orders (see Figure 14). Upon completion of LINK 3, the user would then manually reenter LINK 2, using Game Play File 7 rather than Game Start File 1. This alternating between LINKs 2 and 3 would continue each cycle until the game ends.

However, if the user has been through this process cycle-by-cycle and worked through the original game, it may be desired to run the game through in its entirety -- without stopping for user card inputs along the way. These inputs would be retrieved automatically in LINK 3 (from new orders File 4) at the end of each cycle. This would then permit parameter variation to be handled automatically in the cyclic mode.

To do that, LINK 3 would be read in from disc storage and "rolled over" the core space occupied by LINK 2. Control would then be passed to LINK 3 to begin execution. When LINK 3 processing has been completed, LINK 2 would be "rolled over" LINK 3 and control passed to LINK 2, starting at a point that would read game play data from File 7 (rather than File 1). Play would then resume at the same point that a new time frame begins.

4. Parametric Analysis

In developing MOBACS, it was assumed that it would be used as a research tool for investigation of the usual war game subjects (e.g., weapons, tactics, doctrine, and force mixes) as applied to a MOBA environment. Since

one rarely expects that results from a model will be exactly the same as results from the same situation in the real world, the proper use of most models is that they should be employed to evaluate the effect of variation in critical parameters. In this context, a parameter is any element of tactics, strategy, capabilities, capacities, etc., present in the model.

Another use of parametric analysis is to determine the sensitivity of results to certain parameters where there is a lack of firm numerical values. In these cases a value may be believed to lie within a certain range, and the analysis can provide a measure of its criticality over that range on the effect being measured.

To implement parametric analysis, variation in the game's outcome obtained for several values of a parameter will indicate which values yield superior performance and by careful experimental design involving many such games (samples), valid conclusions may be obtained as to the relative (military) worth of those values. However, the repeated playing of MOBACS to achieve these purposes could be quite a burden on the user. In addition to the constant attention required, obtaining frequent short time intervals on a computer in many installations is notoriously difficult; and the time from submitting input forms to receiving the output reports may be excessively long from the user's point of view.

In order to simplify for the user the exploration of the games' performance for several values of a parameter or sets of parameters, an automatic parameter variation feature is available. This enables the user to specify that the game is to be replayed, but with new values for one or more items of data. The means of doing this is through the use of Card Form 12, which has previously been mentioned in Section 2, and is discussed in detail in Volume III.

It was originally anticipated that the user would explore parameter spaces only in the closed mode of operation. Recall that the player is not required to use LINK 3 to run a MOBACS game. It is used only when the player wishes to suspend execution during a game and either alter existing orders or

input new orders before resuming play. (The times at which LINK 3 is entered is set by the player and need not be at equal time intervals, called cycles.) But by preserving the sets of orders (on New Orders File 4) read in for each cycle, it becomes possible to also utilize parametric analysis for the cyclic mode of operation.

A word of caution is necessary here when the user is contemplating using the automatic parameter variation feature along with the option of periodically modifying or adding orders during a game. Some of the orders may be of the conditional (IF) type, where branching is determined by meeting or failing some contingent test value. It could well be that the (automatically) modified parameter would greatly influence this branching and that (had he known) the player might well have wished to revise the test. Since all automatic "samples" (subsequent to the original game) must be run with the same set of orders, poor military decisions could easily arise. To avoid this possibility, it is suggested that automatic parameter variations be employed only when running the Unit Operations game, where LINK 3 would not be utilized. In this circumstance, the cycle length would be equivalent to the game length.

D. SUPPORTING RESEARCH

During the course of the research program, several supporting areas of investigation were undertaken with various purposes. Some areas of supporting research were design investigations into detail modeling techniques which proved infeasible. In some cases, these proved infeasible due to the lack of any supporting data base; in other cases, the physical process involved simply is not defined in literature and apparently is not known. An example of the latter is the lack of any known physical modeling process for the interruption, propogation and bounce of (radio) communications within the structured environment. Other areas of supporting research were undertaken for the purpose of investigation and preliminavy development of representational techniques for later inclusion in the MOBA Gaming Modes. Brief descriptions of major areas of supporting research are provided below.

1. Test-bed Development Game

An initial "scratch pad" design technique was adopted early in the research program to investigate potential game model techniques - particularly those involving the unknowns of the built-up area environment. This "scratch-pad" design technique was embodied in a Test-bed game structure.

The Test-bed Game was developed to a level permitting demonstration of several basic approaches to simulating combat activities in the built-up environment. That development included programming of the computer model to a level permitting a working conference demonstration in February, 1975. The critique of methods and techniques, and the resulting recommendations indicated that extended development and refinement of the Test-bed game was not warranted; its "scratch-pad" role was fulfilled by providing the basis of the working conference demonstration.

The principal technical areas investigated in the Test-bed Game, and the resulting conclusions were:

- A preliminary terrain representation technique (with accompanying line-of-sight and movement functions) was incorporated in the design. That technique was satisfactory with respect to basic

model structure; however, it became apparent that its terrain representational capability was low, and probably could not be supported by an adequate terrain data base. As a consequence, the present MOBA Terrain Model was adopted in place of the Test-bed Game model.

- The Test-bed Game incorporated a highly discrete, round-by-round simulation of indirect fire with functions for determination of round intercept due to structure masking and structure penetration functions. The model was based on an existing proprietary model called MASK II. Evaluation of program operation concluded that (1) The modeling techniques were technically excellent; (2) the highly discrete nature of the model was inappropriate (a more aggregated method was desired); and, some important operational functions of indirect fire were not considered.

- A close combat attrition-suppression model was incorporated. This model was derived from the suppression modeling technique developed by the Naval Weapons Center (NWC). The model as incorporated into the Test-bed Game was highly satisfactory in this limited modeling application to infantry close combat. However, subsequent design efforts forced the conclusions that (1) the model could not be extended suitably to other facets of combat and (2) full implementation would require unwarranted complexity and program computational effort in the final gaming models.

In designing the Test-bed Game (TBG), several design objectives were established. First was that the unique characteristics of the urban combat environment should be modeled. Thus, the standard techniques of representing terrain (digital grids, probability distributions, polynominal fits) were eschewed in favor of a network-based terrain model for movement and explicit structure representation (using convex polyhedra) for indirect fire.

A second design objective was that the TBG should admit a "zoom-lens" resolution. Thus, units might be moved as batallions during the early part of an exercise and then broken down into companies and finally into platoons as required for later combat assessment. The purpose of this was three-fold. First, play could be significantly speeded. Second, appropriate focus might actually simplify assessment design. Third, input would be called for at the most aggregate level possible, and only when required, thus minimizing data

preparations and processing. This philosophy showed some drawbacks; namely, more complex software and the creation of interface problems.

A third design objective was that the computer modules would be accessed in an interactive time-sharing environment. Several advantages resulted. Computer prompting greatly lessens the learning time for Control, and minimizes the requirement for memorization of procedures. Much of the form-filling could be done automatically by the computer. Input data could be requested as needed, resulting in lessened data preparation, making the TBG highly portable. Some problems were encountered, however; the most serious being that the operator might enter incorrect data or mistype an entry. At best, this caused erroneous results. At worst, it caused fatal program termination.

The Test-bed Game setup is indicated in Figure 16. The game was played in discrete time slices, called frames. The frame length could be varied as the game progressed. The player teams had the opportunity to submit new orders, fire missions, and inquiries at the beginning of each frame. Control prepared these items for computer processing and input them at the time-sharing terminal. The sequence of operation is shown in Figure 17.

A more detailed description of the TBG design is provided in Volume 1: Methodology. Since the TBG was an interior, developmental research tool, formal documentation was not prepared; however, internal draft documentation, including program listing exists, and may be requested.

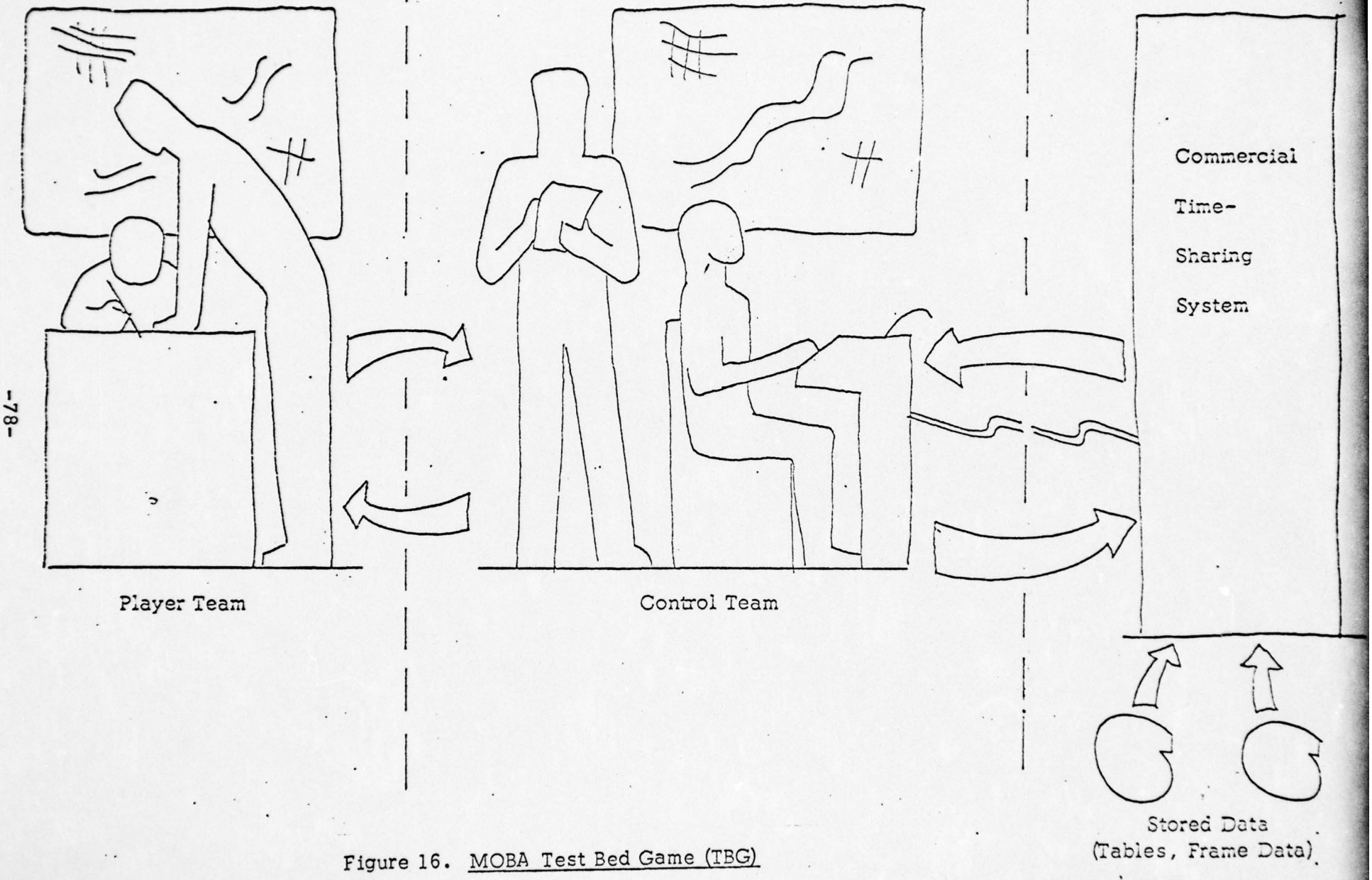


Figure 16. MOBA Test Bed Game (TBG)

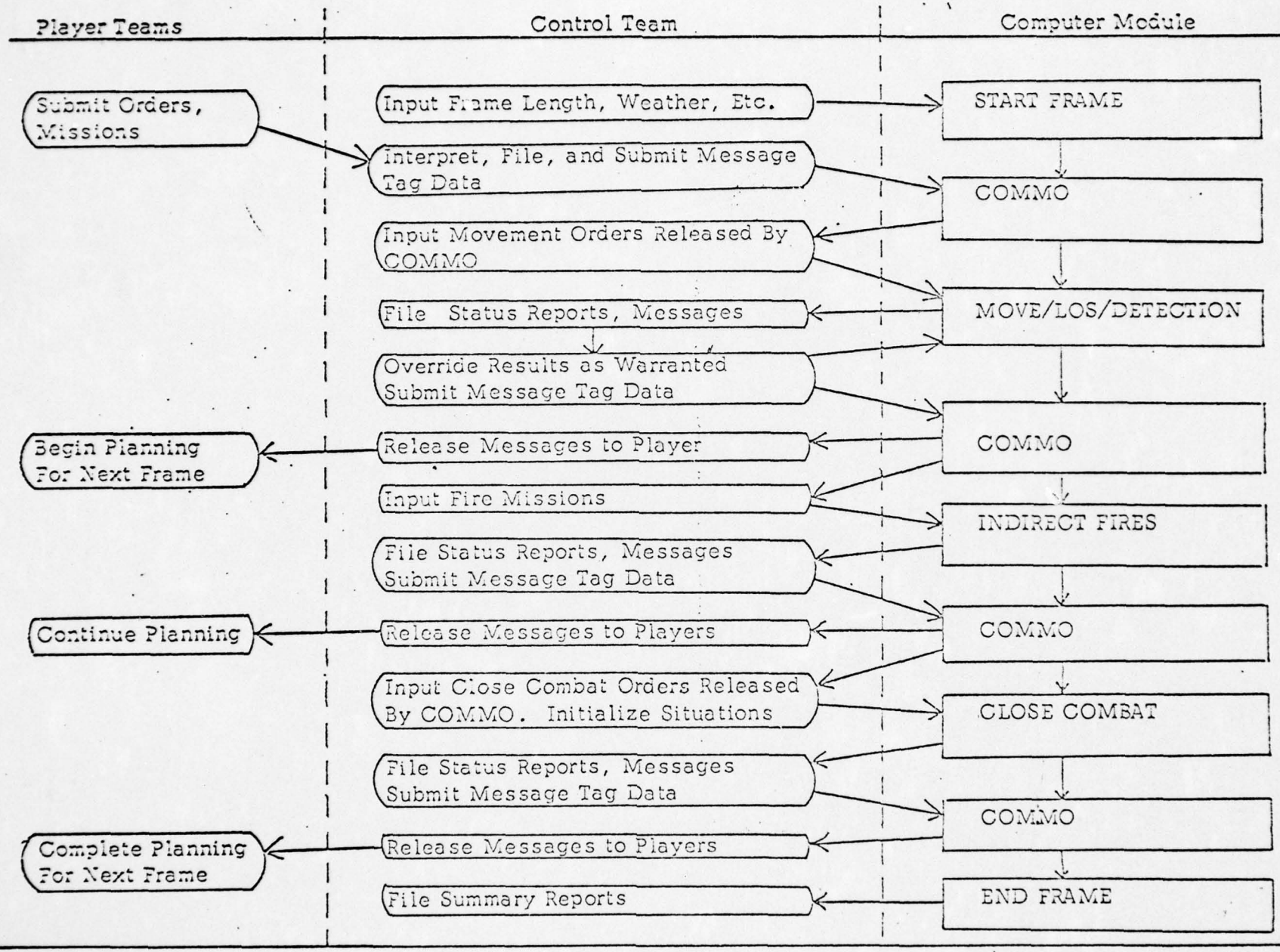


Figure 17. MOBA TBG Macro-Structure

2. Scenario Operations Planning Model

Early technical effort in the research program sought to establish a design for an all manual, "quick-gaming" map board game with tabled data for assessment of outcomes. That design was carried to the extent of defining the procedural flow in some detail. However, it became apparent that the provision of the necessary data for assessment and outcome was not feasible within the current research effort because:

- To stay within the bounds of manual manipulation, it would be necessary to adopt very conventional assessment techniques such as those predicated on IFP's (indices of firepower) and casualty rates as a function of force ratio.

- Predication of effective IFP's (i.e., multipliers for IFP's), considering structures and structure penetration was quite difficult. Further, no acceptably brief calculation procedure could be conceived of which would enable gamers to calculate adjusted IFP's during the game.

- Present structures of manual game assessment are substantially predicated on Attacker/Defender force ratios. The force ratio-based data existing in present games, for the most part, represents a gradual accretion of "judgemental factors" over the past 20-odd years. There is no substantive model underlying the data; therefore it was impossible to disassemble the data structure, modify it, and augment it with built-up area related factors.

- The only practical means of obtaining the summary level outcome assessment data needed was judged to be very extensive running of the computer based gaming models to generate tabled data on a case entry by case entry basis. Such effort was not available within the program scope.

A manual, quick gaming method was originally considered for two basic reasons: (1) as an initial "first cut" evaluation tool and (2) as a means of generating a detailed operations scenario (plan) for structuring the input to the Force Operations Level Game. Because of the difficulties in constructing assessment tables (cited above), it was necessary to abandon the first goal for a Force Operations Planning Game. The second goal - scenario generation - was considered

essential to the other gaming models; therefore, the structure (procedural flow) of the originally intended Planning Game was adapted for use in generating a MOBA scenario.

In the adaptation of the manual game structure, a technique of "possible event" generation was employed. That is, subjective definition of ensuring (resultant) events was sought, rather than the more usual method of measuring event outcome. It is noted that this results in what is effectively a very standard staff operations planning exercise, a part of the basic repetoir of skilled military gamers. As a result, no extensive documentation of the partial game design is given; rather, a summary description of that intended design is given - primarily as a report of research performed. That description is provided in Volume 1: Methodology.

III. EXERCISE AND EXTENDED DEVELOPMENT

A. METHODS

This section describes the general results of exercise and extended development of the Gaming Models for Military Operations in Built-Up Areas. Exercise and extended development was undertaken with the purpose of demonstrating the operability of the gaming models and for the purpose of validation aimed at discovering and correcting weaknesses. Exercise and extended development followed two basic paths. First, trials of basic design structures and techniques were conducted at various points throughout the program for the purpose of verifying methodology. Second, operational trials of the developed design were conducted.

1. Design Development Exercise

Design development exercise consisted of three separate exercises. First, an exercise and demonstration of a design development Test-bed Game was conducted to provide a demonstration, and an opportunity for substantive critique, of basic approaches to the simulation of combat activities in the built-up area. Second, an extended map exercise was undertaken to demonstrate and confirm the essential elements of design. The map exercise also was undertaken to demonstrate the development of situational inputs for the game simulation structure. Third, initial system trials were conducted on the MOBACS system macro-structure to validate the interoperability of major system components.

2. Operational Trials

The objectives of operational testing were to establish the overall systems operability of the MOBACS simulation and to validate specific submodel responses within the system. The program of operational trials was structured to verify that the overall model functioned properly as an integrated system and would acceptably represent a structured input situation. In addition,

the trials were aimed at ensuring that various components performed in the desired way.

It was recognized at the outset of the research program that a certain degree of "open-endedness" was necessary with respect to the final MOBA Gaming Models design. The research sought to design, develop and exercise research gaming models for MOBA with the prospect of being operated in the research mode. Beyond this, no specific user, user application, or user installation was specified. This condition restricted the development of user and user facility related procedural elements to the specification of a framework of game procedural requirements; concentration of effort was on the game models themselves. With respect to operational trials and validation, some consideration of method was necessary.

Full-scale, team play trial operations of the games would require, at the minimum, a temporary or trial installation of the game; however, none was contemplated by the original program. Therefore, the general possibilities of approach to verification and validation were considered. The first method considered was simply the duplication of identical test problems in as many ways as possible using similiar games or simulations. Since the defining need for the current research program was that no models or simulations of urban combat existed, the duplicative method of verification was unavailable. The second alternative was parallel development and comparison of two "independent" efforts. In addition to the prohibitive inefficiency of the method, it lacked any positive verification, providing only another look at the same problem.

The third considered method was to impanel a group of military officers experienced in employment of the types of systems and operation tested, with the object of assessing relevance, validity, and comprehensiveness through good military judgement. This is a relatively low-cost and effective means of verifying a game. Despite the often labled criticism of the imprecisions of this method and the fact that it is subject to substantive challenges, it is frequently

used. Moreover, it may be specifically chosen, if only as an ajunct means of verification. In the present case, two facts mitigated against the adoption of this method: (1) it requires a game installation - at least a temporary installation - to conduct such trials, when none was programmed; and, (2) the impaneling of expert military experience in MOBA operations posed a considerable problem - there existed no cohesive promulgation of MOBA doctrine or tactics as their guidelines for evaluation.

A fourth method that was considered was historic verification. Aside from the general intransigence of this method, two principal reasons caused rejection: (1) the necessary historical research could not be undertaken within the limits of the present research program, and (2) the most available data (World War II and possibly Korea) suffers badly from the aging of the concepts of organizations, equipment, and doctrine.

As a result of the above considerations, it was determined that the approach to operational trials should be one of:

- Operation of the game models (program systems) in a format in which the inputs arising from player actions are systhesized from a predefined game scenario of operations.
- Operation of the MOBACS simulation in the closed (noncyclic) mode.
- Assessment of the overall system operability with a general, small force situation trial.
- Examination of selected system component response functions through the structuring of situational incidents and parametric variation of selected variables in the situational incidents.

It was determined that the creation of situational incidents for system component response evaluation could be done by using the basic input structure from the situation for overall system operability trial. This could be done by selecting, through initial input orders, unique isolated situations. For example, the response function (unit casualties) for a given type unit subjected to a standard indirect fire mission could be examined for a range of unit

dispositions (i.e., variations of surrounding structure effects) by: (1) deploying multiple units of the desire type, each in a selected, separate disposition, (2) directing a standard fire mission at each target (disposition) in succession, and (3) examining the results in the context of the variations of cover and protection provided the units. Additional examination could be made by (automatically) replicating the example several times and selectively varying input parameters on each replication.

B. MAP EXERCISE

An extended map exercise was undertaken to demonstrate and confirm the basic requirements for generating situational inputs for the Force Operations Level Game. An output history of the situation generated by this map exercise is given in Appendix A; this section contains a summary discussion of purpose, methods, and results.

1. Purpose

The purpose of the extended map exercise was threefold:

- The map exercise was used to demonstrate the creation of a detailed force operations scenario in the MOBA environment.
- The exercise was used to provide a basis of verifying that the gaming models being designed recognized an adequate scope of possible types of operations in the built-up environment. That is, the exercise was used to validate the elements of design in the Gaming Models for MOBA structure.
- The map exercise was used to demonstrate the predicated requirement for structuring input data for the Force Operations Level Game.

Since the purpose of the extended map exercise was, in general, verification of design technique, the exercise was conducted during the mid-period of the research program. At that time, a full-blown attack/defense of a built-up area was considered a representative situation. Subsequent doctrinal developments and threat evaluation (within TRADOC) have suggested that a situation based on the attack/defense of an interconnected village area may be a more

realistic scenario. That newer situational concept was not exercised; however, it is believed that certain phases of the exercise undertaken - particularly the initial phases - contain many of the essential elements of the interconnected village concept.

2. Method

The extended map exercise was conducted as an open map/situation analysis, using a team of analysts alternately evaluating Blue-side operations then Red-side operations. The exercise was guided by a formal procedural flow - a preliminary model for a map planning game - but no calculated outcome assessments were made. Rather, a technique was used to develop the sequential flow of multiple events and outcome options within four phases (divided segments) of the overall operation. The scenario is based on a Red threat force of Regimental size (mechanized infantry and armor) attacking a battalion-sized U.S. defending force. The sequence of the exercise divides into four phases:

- Phase I. Initial Disposition of Forces and Initial Contact
- Phase II. Attack from the March/Defense
- Phase III. Continuation of Attack/Defense
- Phase IV. Airmobile Assault/Defense

The map reference for this exercise was the 1:25,000 series of the immediate area of Koblenz, West Germany (i.e., the terrain area of the "typical" built-up area, Western European Site 2). During the conduct of the exercise, heavy reliance was placed on the definitions of threat force organization for combat, doctrine and tactics contained in:

> "Combat Action of a Motorized Rifle Battalion in a City", a translation of an unclassified Russian document authored by MajGen. A.K. Shovkolovich, Col. F.I. Konasov, and Col. S.I. Tkach.

3. Results

The extended map exercise developed a situational scenario which covers

a fairly broad spectrum of combat in the built-up area. Informal review of the results by military officers was generally favorable, concluding that (1) the event sequences are plausable, (2) the basic conduct of threat operations seems reasonable, and (3) the spectrum of combat activities is representative of the MOBA problem.

Criticisms of the developed scenario included: (1) the general situation from which the scenario develops is unrelated to contemporary planning in Western Europe, and (2) some tactical developments, while plausible, probably do not represent best military judgement. An example of the latter occurs in the initial main (Red) attack into a "pocket" in Blue main line of defense: Red is attacking without preliminary holding actions on the flanks - particularly the right flank. These criticisms were not thought to detract from the overall scenario in any substantial way for the purposes intended.

The extended map exercise fulfilled the intended purposes of providing a basic scenario in the MOBA environment, verifying basic elements of design in the gaming models, and providing a structural basis for developing input data for the Force Operations Level Game.

C. SIMULATION EXERCISE

Simulation exercise consists of three separate areas of investigation: (1) initial development trials of the simulation macro-structure, (2) overall system trials of the MOBACS simulation, and (3) response analysis of system components. Additionally, simulation exercise requires detailing of a simulation input scenario and input data development from the original scenario developed with the extended map exercise.

1. Purpose

The purpose of the simulation exercise was to establish the overall systems operability of the MOBACS simulation and to evaluate for validation the response of specific submodel functions within the simulation.

The simulation exercise aimed at examining the Gaming Models for MOBA structure from the model functions outward to the game "facility interface". Specific player/facility related procedural elements were synthesized and imbedded in a structured input scenario for the simulation, with simulation outputs - corresponding to basic player output information - being examined for reasonableness and content.

2. Initial System Trials

Initial system trials were conducted to assure the operability of the macrostructure of the MOBACS simulation; in particular, the trials were conducted to validate the interoperability of the three principal processor modules of the simulation (i.e., LINK 1, LINK 2, LINK 3) and to test the capability of each module properly call routines and subroutines.

The initial system trials were conducted prior to the detail completion and checkout of several interior subroutines; therefore, dummy routines were used in some areas -- the principal ones being the terrain data access subroutines. However, the primary interest was in validating the input data processor link, the generation of the initial game play data tape, proper sequential calling of subroutines in LINK 2, the generation of periodic output reports, and the periodic (input) processing of orders through LINK 3.

Initial system trials produced satisfactory results, but they also indicated that a formal executive subroutine in LINK 2 could be replaced by a more direct, in line program calling sequence for the operating routines of LINK 2. As a result of this observation, the previous executive subroutine was removed and a direct in line program sequence was substituted.

Initial system trials also indicated that large amounts of program processing time were being spent in the determination of possible unit-to-unit contact. This occurred because each unit of each side (Red and Blue) systematically checked each opposing unit for possible contact in each interval of calculation. It was estimated that this could easily require upwards of

10,000 unit-to-unit contact checks per computation interval when near-maximum force sizes were employed. It was felt that this number of computations - each containing a significant amount of processing to determine possible intervisibility - would cause unwarranted program running time. As a result, a new subroutine (SEARCH) was designed to effect a preliminary command group to command group scan for potential contact. Specific unit-to-unit contact (targeting) checks then were made within the established command group contacts. This change resulted in the reduction of the potential unit-to-unit contact checks within a processing interval to an estimated 1,500 for near-maximum force sizes.

3. Test Scenario Developments

As a preliminary step to the conduct of system trials and examination of submodel responses, a subset of the overall extended map exercise scenario was constructed and detailed for game input. This subset - or "slice" - of the overall scenario was taken from the supporting attack sequence on the threat left. It considered an augmented battalion sized, infantry/armor threat force against a blue company-sized force with supporting fire. The basic adaptation and detailing of the scenario is summarized in Appendix B.

In addition to the above force scenario, stylized and isolated situation sequences - derived from the force scenario - were required to provide controlled condition response tests for various submodel functions. An example of such stylized situational sequences also is given in Appendix B.

4. System Testing

System testing of the gaming models was laid out with the aim of verifying that the MOBACS simulation functioned properly as an integrated system. This testing called for the proper processing of system inputs, reproduction of realistic combat results output, and proper execution of parameter variation tests.

The input data processor (LINK 1) of the system provided for processing of specific sets of input data. Each subroutine also does editing of input data,

prints diagnostic messages on detected input errors and writes game start data to tape (or disc). The input data processor also establishes the automatic game replays with parameter variation. Proper system response was required for each of these functions with the trial scenario.

The combat simulation processor (LINK 2) of the system provides for processing the established combat situation in each calculation time step through the sequential steps of (1) setting all order-initiated conditions and actions; (2) determining force element contacts; (3) setting indirect fire events and targeting direct unit-on-unit firing; (4) processing all firing events; and (5) updating the status of all units at the end of each calculational interval. LINK 2 also outputs all player intelligence and periodic reports. The required system performance included proper logical, sequential processing of all program functions; proper computation of all elemental conditions; proper maintenance of limit and program status; and, generation of output reports.

The LINK 3 processor provides for the processing of periodic (cyclic) input orders; it functions are analogous to an abbreviated form of the LINK 1 processor. Required system performance for the LINK 3 processor included (1) proper input processing of cyclic input order batches - particularly for the ability to link to existing order sequences; (2) proper editing of input; and (3) proper storage and recall functions for the progressively assembled file of orders.

5. Component Testing

The object of component testing was to establish the accuracy and behavioral characteristics of elements of the physical modeling contained in the combat simulation processor. The basic method set out for this testing was that of (1) structuring stylized situational input situations (to achieve control of unvaried parameters), (2) synthesis of a parameter variation sequence, and (3) examination of output response from the structured trials. It was felt that, since the number of trials could grow quite large, and since research program limitations - particularly under the conditions of program shortfall -

restricted the number of trials attempted, emphasis on component testing should be on the relatively unique built-up area related modeling.

It was felt that the primary model areas which should receive priority for testing were (1) the disposition and placement of units within the built-up environment (as represented by the terrain model); (2) the development and maintenance of contacts (primarily examining the intervisibility function); (3) the generation of and the effect of indirect fire on units situated in structured locations; and (4) close combat in structured areas.

It was considered necessary to isolate effects in each of these examinations. Therefore, an elemental situation technique was defined. For example, in testing for disposition and placement, a sequence of trials could be structured with a double, ordered variation technique:

- Multiple identical units could be deployed to positions selected from the terrain environment to represent a range of structured area conditions. This gives variations of conditions with control of any unit variations.
- The deployment could be replicated, varying selected input parameters.

Similarly, for indirect fire, multiple identical targets could be located in specifically varied locations to give controlled target conditions. Then, a variety of mission could be fired at the targets to examine the resultant effects (and, with variation of input weapon parameters).

D. EVALUATION

Evaluation of results has resulted in both summary conclusions and recommendations for continuation of development of the Gaming Models for MOBA.

1. Conclusions

The conclusions reached as a result of the research program to design, develop, and exercise Gaming Models for MOBA are:

- Gaming Models Design. As designed the gaming models can accomodate the representation of combat in the built-up area for various types of land forces such as infantry, armor, mechanized and air mobile, together with support fire functions. The method of two levels of gaming permits successively detailed examinations of combat operations of forces; and this method is primarily suited to the examination of research problems with the games operated in the research mode. The models require carefully detailed initializing input data which may be relatively unique to each research problem. This characteristic is the result of design intent: maximum flexibility for description of concepts of operations, forces, and weaponry has been gained by deliberately exposing large blocks of descriptive, defining parameters as input data. This characteristic has the advantage that a minimum of pre-conception of operations, forces, and weaponry is "locked into" the gaming models design. Under the conditions of operation as research gaming models in the research mode, this is both an acceptable and desirable characteristic. Under other modes of operation, however, this characteristic may prove somewhat cumbersome, since it does introduce difficulties in the creation of "standard" data banks from which game input may be initialized rapidly. The gaming models design provides for analytic investigation of concepts primarily through concept comparison and through systematic detail investigation by the method of selective variation of input parameters and automatic replication of game play for each variation sequence (in the Unit Operations Level Game only).

- Game Operability. The underlying contractural conditions of the research program precluded the identification of a specific user site and installation facility. This required that the gaming models be designed with the bulk of the player/facility procedural rules specified, but not detailed. The overall procedural requirements are specified to a basic interface between player input and the computer related gamin models programs. All gaming models and related programs a specified in detail. Descriptions of the game operating

characteristics from the user viewpoint are provided. Complete data input forms, including player order input forms, are specified, together with user instructions. As a result, the core of the Gaming Models is operational; however, full-scale player operability is dependent on future user installation.

- MOBACS Simulation. The MOBACS simulation resulted in an extremely flexible design, capable of representing military operations in the built-up area. The simulation is predicating on extending and adapting conventional combat simulation techniques by augmentation with (1) a terrain model for the structured built-up environment, (2) incorporation of player defined input to effect the disposition and placement of units within the built-up area environment; and (3) terrain-related functions represent combat functions interacting with the built-up environment. The simulation is considered to have satisfactory operating and response functions; however, some caveats must be noted:

(1) Many of the detailed modeling function have been structured on a "first principles" basis since previous research and experimental data does not exist. Because of this, the response functions of some submodels can be viewed only in the light of "do they function as designed, and do they have apparently rational response?".

(2) Certain operations, when simulated in the model will lead to very slowly developing situations - e.g., a more or less stalled condition when units are fighting in and among structures. This is thought to be realistic; however, it portends problems in machine operating time for the simulation. The simulation has no method of "skipping over" or condensing such slowly developing situations and may require very extensive running time to generate a conclusion. Although it has not been tried, it may be possible to artificially terminate such situations (presumably declaring an extrapolated outcome status), then reinitialize a new starting game condition.

(3) In a similar fashion, the effects of indirect fire on targets located

within heavy structures are extremely difficult to verify in any rational way. The effects may be very slowly cumulative. Whether that rate is accurate with respect to real life is difficult to determine; only minimal data exists and that suggest only that fire effects can be slowly cumulative. The model responds in this way; therefore, one minimal damage may accrue in short simulation periods. Conversely, the demonstration of significant damage levels may require very extended operation of the simulation.

(4) The terrain model is considered to produce adequate representational factors, but two conditions are indicated for future improvement. First, the same data is used for both the Force Operations Level Game and the Unit Operations Level Game. The terrain model resolution is considered very satisfactory for the former game; however, finer-grained resolution probably could benefit the latter game. The terrain model could be recompiled at finer resolution, but the data storage requirement would expand rapidly. A method of generating fine-grained subsets of the terrain data is an area for future improvement. Second, the data for European Site 1 suffers from positional location error of features. This is an unavoidable consequence of the poor and limited original data (photomosaic only), and would require complete regeneration of the model data to correct. The data model, as it stands, is considered acceptable for use, but some inconsistencies between map and terrain data model will occur.

2. Recommendations

The primary recommendation made is that the Gaming Models for MOBA be adopted for a specific user installation by the U.S. Army Training and Doctrine Command (TRADOC). This installation should include:

- Transfer of gaming models programs to user computer facility.
- Development of a detailed facility/player procedural manual, derived from the current user documentation, but extended to include explicit game room procedures, statusing and display procedures, and interfacing

controller staff procedures.

- Initial training of game staff personnel.
- Extended, full play operational checkouts on the installed game.

It is further recommended that a corollary effort be undertaken to extend the response analysis functions of the submodels of the game. This extended effort would particularly include the definition (with the model) of field testing requirement to develop data in areas that are currently lacking.

APPENDIX A

PLANNING MAP EXERCISE

INTRODUCTION

This appendix gives the recorded results of a free playing map exercise to generate a basic MOBA scenario. The purpose of generating the scenario was the verification of preliminary procedural requirements for developing a detailed input scenario for game play in the MOBA Gaming Models. The basic procedural requirements needing verification were

- That suitable MOBA-related scenarios were required for the examination of research problems of force structure, weapons mixes and related problems.
- That a prior situation (operations plan) could be generated from which the required input data structuring for a game could be developed.

The conduct of the map exercise was free play within a procedural framework to generate a stream of potential events. The outcome of these events was not assessed quantitatively; rather, plausible subjective outcomes were derived for several possible events in each subsequence of play.

Conduct of the exercise was broken into four distinct, successive phases. Although the successive phases were continuations of the same overall force operation, each phase is largely self contained.

In the conduct of the exercises, heavy reliance was placed on the definitions of threat force organization for combat, doctrine and tactics contained in:

"Combat Action of a Motorized Rifle Battalion in a City,"
a translation of an unclassified Russian document.

The remainder of this appendix is divided into five parts. These are

Part 1: Situation

Part 2: Phase I, Initial Disposition of Forces and Initial Contact

Part 3: Phase II, Attack from the March/Defense

Part 4: Phase III, Continuation of Attack/Defense

Part 5: Phase IV, Airmobile Assault/Defense

Also, three supplements to the appendix appear:

Supplement 1: Blue Fire Support Plan

Supplement 2: Blue Task Force Organization

Supplement 3: Red Task Force Organization

Supplement 4: Red Airmobile Operation Planning Data

The map reference for this exercise is the 1:25,000 series of the immediate area of Koblenz, West Germany. Throughout the exercise documentation, references are made to a series of overlays. The reader should recognize that the actual overlays have not been reproduced; rather, summary phase situation maps appear for each phase. These phase maps generally summarize the contents of the overlays.

PART 1: SITUATION

A. GENERAL SITUATION

1. Red Attacker
2. Blue Defender
3. Red Advance to Contact and Main Attack

B. SPECIAL SITUATION

A. GENERAL SITUATION

1. Red Attacker

On (date), the 38th Mechanized Rifle Division captured, intact, the REMAGEN Bridge, south of BONN. Following elements of the 20th Combined Arms Army crossed the Rhein River and expanded the bridgehead. Major Aggressor forces moved north, to capture the FRG Capital and isolate the industrial RUHR. The 38th Mech. Rifle Div. was directed to move southeast, seize crossing over the MOSEL River and the railroad nexus in KOBLENZ, thus cutting rail traffic south to the SAAR industrial basin and west to France.

The 38th Mech. Rifle Div. moved southeast in two columns, the 278th Mechanized Rifle Regiment (plus) on the left, via Route 9, generally following the west bank of the RHEIN River; and the division (minus) moving via Route (new autobahn) on the right, with the 280th Mechanized Rifle Regiment leading, see Overlay No. .

2. Blue Defender

Immediately following Aggressor's surprise RHEIN River crossing, the 20th Infantry Division sent its 3d Brigade northward to cover the MOSEL River crossing sites and railyards in the KOBLENZ area. The Brigade established an initial defensive position along the west-east ridgeline to the north of the junction of the MOSEL and RHEIN Rivers. Depending on the fighting north and south of this area, Blue was to be prepared to attack north and destroy the Red forces west of the RHEIN River, or to fall back south of the MOSEL River, destroying all bridges, and holding the south bank with an eastern anchor in the City of KOBLENZ.

3. Red Advance to Contact and Main Attack

The main attack column of the 38th Mech. Rifle Div., thrusting down Route (new autobahn) came under fire of the Blue Combat Outpost Line as it exited the wooded area northeast of BASSENHEIM (91-80). The Advance Guard of the 280th Mech. Inf. Regt. drove furiously, but while pushing in the Blue outposts, could not progress beyond the (east-west autobahn from FRANKFURT to DAUN-WITTLICH-TRIER). Both the 280th and 281st Mech. Inf. Regts. were committed in heavy fighting along the autobahn, extending from the orchard north of RUBENACH (94-80) southeast to the woods west of WOLKEN (90-77).

B. SPECIAL SITUATION

The Red 278th Mechanized Rifle Regiment, part of the 38th Mechanized Rifle Division, was assigned Route 9 for its move south, out of the REMAGEN bridgehead, with a dual mission: seize the bridges across the MOSEL River at KOBLENZ and the railroad nexus in that city; and protect the divisions east flank during the march to the MOSEL. The regimental reconnaissance platoon provided security on the regiments east, proceeding by secondary-tertiary roads next to the RHEIN west bank, checking for usable bridges/river crossing attempts by Blue elements east of the RHEIN. The regiment advanced in a single column 40 kms long; with its 1st Bn (Reinforced) acting as advance guard (See Figure 1, Order of March).

The Red 280th Mechanized Rifle Regiment, on the new autobahn route, makes contact with Blue 1-71st Inf. and 1-72nd Inf. at 1530 hrs. on 0108 and presses a subsequent attack from the march by 281st Mech. Rifle Regt. through the 280th line of contact. Progress of the attack is effectively halted by Blue Forces by 2300 hrs.

The Red 278th, traveling on Route 9 parallel to the 280th, was directed by Commander, 38th Div. to halt at present position at 1600 hrs. pending development of contact by 280th and pending determination of strength and disposition of enemy forces. Upon Co. 38th Div's decision to commit 281st (1900 hours), 278th was redesignated Division Reserve Echelon with contingent orders to

(i) Alter route of march and prepare to attack through the left flank of 280th line of contact on command, or
(ii) Be prepared to resume current route of march with original mission.

PART 2: PHASE I

A. INITIAL SITUATION

1. General
2. Blue Sitrep
3. Red Sitrep

B. BLUE FORCE OPERATIONS PLANNING

1. Analysis of Situation
2. Unit Tasks
3. Plan of Operations
   a. Organization for Combat
   b. Blue Overlay #1
4. Support Fire Plan

C. RED FORCE OPERATIONS PLANNING

1. Analysis of Situation
2. Unit Tasks
3. Plan of Operations
   a. Organization for Combat
   b. Order of March
4. Support Fire Plan
   (See Overlay)

D. SITUATION ANALYSIS

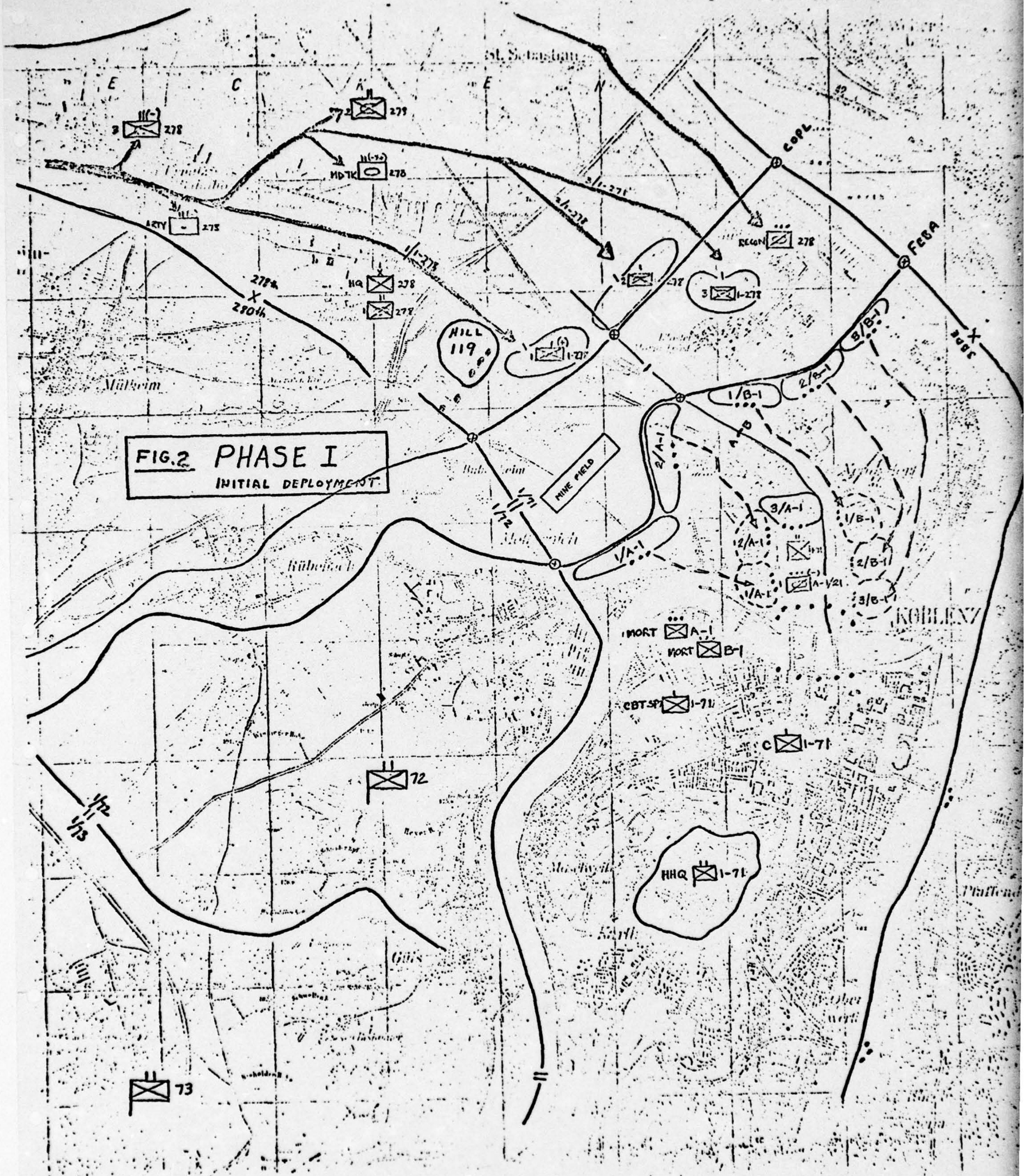


FIG.2 PHASE I
INITIAL DEPLOYMENT
MINE FIELD
HILL 119
COPL
FEBA
KOBLENZ
278th
280th
RECON 278
HQ 278
ARTY 278
MORT A-1
MORT B-1
CBT SPT 1-71
C 1-71
HHQ 1-71
72
73
1/A-1
2/A-1
3/A-1
1/B-1
2/B-1
3/B-1
B/B-1
A-1/21
1/1-278
2/1-278
3/1-278
Mülheim
Kübelach
St. Sebastian

INITIAL DISPOSITION OF FORCES
AND INITIAL CONTACT

A. INITIAL SITUATION

1. General

Initial situation is that of Special Situation with the following additions:

a. Blue force has arrived in KOBLENZ area. As of 0800 hrs., 0106; maneuver battalions have made initial deployments in previously assigned battalion areas of responsibility. Commander, 3rd Brigade directs Commander 1st Bn. 71st Inf. to prepare plan of defense for 1st Bn. sector within general concept of operations:
(i) Main line of defense is MOSEL River
(ii) Prepare to conduct initial delay operations north of MOSEL on the line of Route 9 and the railyards, crossing the MOSEL . . . bridges into south bank area.
(iii) Forces available; (see Blue Task Force Troop List).

b. Red force (278th Mech. Rifle Regiment) was directed to hold in present route march position in vicinity of at 1530 hrs., 0108 until 38th Div. Commander could determine strength and disposition of Blue forces opposing 38th Div. 1st Echelon. Commander 278th is directed to prepare to
(i) Alter route of march to align for second echelon attack passing through 1st echelon line of contact if 1st echelon succeeds in driving in Blue defensive positions.
(ii) Resume present route of march, driving on KOBLENZ to secure a river crossing, to turn Blue's right flank, if 1st echelon cannot drive in Blue defensive positions.
The 1st echelon's progress - including an attack from the march following development of contact -- was effectively halted 2300 hrs., 0108. Commander, 38th Div. directed the 278th to resume its march on KOBLENZ.

2. Blue Sitrep

Control-to Blue
Period Covered: 0106 0400 - 0106 0800

Sitrep No. 1
Map Ref: KOBLENZ 1/25,000

a. Enemy

(1) Units in contact
NONE
(2) Known enemy reserves
UNKNOWN
(3) Enemy activity
Unreported since 1530 hrs., 0105 due to low overcast condition, preventing air reconnaissance. Last intelligence indicates massing of division-sized forces in RHINE bridgehead area. Southward movement assumed imminent, with earliest estimated arrival in KOBLENZ area 1700 hrs., 0108.
(4) Estimated strength
1 Division
(5) Courses of action
(i) Likely main avenue of advance (main force) is Autobahn
(ii) Likely alternate, or 2nd Echelon route is Route 9.

b. Own Situation

(1) Location of forward elements (omitted)
(2) Location of units, Hq., and boundaries (See special Situation Overlay)
(3) Location of adjacent and supporting units (See Special Situation Overlay)
(4) Own operations - Arrived designated battalion sector, 0720 hrs., 0106
(5) Noneffective units
NONE

c. General

Low overcast conditions are forecast to continue through 0113; no tactical air operations appear likely during this period.

d. Subordinates evaluation
(Omitted)

3. Red Sitrep

Control to Red — Sitrep No. 1
Period Covered: 0108, 1700 - 0108, 2300 — Map Ref: KOBLENZ 1/25,000

a. Enemy

(1) Units in contact - 2 infantry battalions plus elements of mechanized infantry.
(2) Known enemy reserves
UNKNOWN
(3) Enemy activity
Blue occupies strong defensive positions on commanding high terrain, with defensive line oriented along Autobahn . Defenses have successfully countered our initial contact (1500 hrs.) and subsequent attack by 2nd Echelon, 280th Regiment.
(4) Estimate strength - 3 battalions, reinforced
(5) Courses of action
Enemy is holding strongly; not likely to withdraw unless penetration to MOSEL endangers his route of withdrawal.

b. Own situation

(1) Location of forward elements - (omitted).
(2) Location of units, Hq., and boundaries - 278th Mech. Inf. Regt. holding, vicinity of
(3) Location of adjacent and supporting units - (omitted).
(4) Own operations
(i) Initial contact by advance guard, 280th at 1500 hrs., drove in enemy outposts on ridge line.
(ii) 2nd Echelon, 280th, attacked from march at 2000 hrs.; now holding positions in contact with enemy main line of defense.
(5) Noneffective units
NONE

c. General
Enemy positions facing 280th appear strong; effective artillery fire support coming from south, probably from battery positions south of MOSEL.

d. Subordinates evaluation
(Omitted)

B. BLUE FORCE OPERATIONS PLANNING

1. Analysis of Situation

If a city is part of a defensive line, it will probably have a linear defense, with reserves and supporting weapons behind the line. If, however, the city has been enveloped and isolated, the defense must be prepared to face attack from any direction. Attack from any direction suggests a perimeter defense, with all support elements enclosed in the protective circle. However, a perimeter demands a large number of troops, or implies a thin line that may be pierced by an enemy concentration.

Alternatives involve shrinking and/or splitting the boundary perimeter into a single dense bastion in the most defensible sector of the city; or a series of mutually supporting small perimeters (hedgehogs) scattered through the city. In each case, support weapons are emplaced and protected inside the defended area(s). The problem with the shrunken single bastion is that the enemy may bypass the area, leaving a small besieging force, and continue its operations unmolested. For the series of small perimeters, mutual support within a city is frequently negated by intervening structures for line-of-sight weapons, and masks for indirect fire weapons, and additionally, considering an infantry battalion, by hedgehog separation distance necessitated by the minimum range of the principle battalion weapons, the mortars. For example, with three rifle companies and a combined Bn Hq-combat support co hedgehogs, their centers would have to be 850 meters apart in order to fire a final protective ring around the neighboring hedgehog; or the battalion bastion would have to have a radius greater than 850 meters for close support fires by mortars centrally located.

For the initial delaying position north of the MOSEL, the battalion commander took a third alternative, placing 2/3 of the rifle units forward in the delaying position, and 1/3 plus the entire internal battalion indirect fire support in the rear, final defensive position. By this arrangement, battalion and rifle company mortars could provide close support-final protective fires, but were not positioned to place fire at long range in front of the urban defensive position. The battalion's share of direct and general support artillery were alloted the longer range fire missions. The "spread positioning" of the mortars (linked via the city telephone net), permitted one or more tubes to fire (since the majority of structures are not over 2-3 stories) at an estimated 85% of the street intersections, at 90% of the buildings, and at 50% of the streets along their axis between intersections.

The battalion commander placed his attached tank platoon in the vicinity of the three bridges, with quick access to streets going west, north or east, but with priority to the west, as his mobile, quick-reaction reserve. The 3d platoon of A Co., astride the central route into the position, provided some depth to all the front line platoons, except the 3d platoon of B Co., next to the RHEIN River flank. C company, south of the MOSEL River, was to assure destruction of the bridges to prevent enemy use; to maintain them intact for Blue use until Red reached the northern approaches to the bridges; and to patrol KOBLENZ to prevent enemy infiltrators attacking the spread battalion mortar positions.

2. Unit Tasks

a. 1/73 - Occupy FEBA w/2 platoons, place one platoon in copse atop ridge overlooking railyard. Mortar platoon, see H&H Hv Mortar Pl. instructions.

b. 1/73-Occupy FEBA w/3 platoons. Mortar platoon, see H&H Hv Mortar Pl. instructions.

c. 1/73-Prepare alternate defensive position on the citadel; detail one squad to guard each bridge over the MOSEL in the battalion area, to prevent sabotage of the bridges or demolitions emplaced for emergency detonation. Be prepared on command to cover withdrawal of battalion units over any of the 4 MOSEL River bridges. Mortar Platoon, prepare basic fire plan for all battalion mortars in the KOBLENZ area south of the MOSEL River, but take initial positions south of the MOSEL able to provide fire support to A Co.

(1) H&H 1/73 - Hv Mortar Platoon: Set up Bn FDC, coordinate mortar fire of A and B Co. mortar platoons to cover suburbs of KESSELHEIM, WALLERSHEIM, NEUENDORF, LUTZEL close support fires north and west of the FEBA. Mortar Platoon leaders and sergeants be particularly alert to locate firing positions for mortars to cover the maximum number of areas within the city; mortar firing positions will be south of the MOSEL. FO's be particularly careful to pick positions permitting observation of fire effects, and report avenues of approach to your defended area which are not under your observation, but which may be seen by another FO. All separate mortar squads tie in via the city telephone lines with your FDC.

(2) Scout Platoon put one squad each at a bridgehead east of the RHEIN to guard the ASTERSTEIN and PFFENDORF bridges against sabotage or preliminary explosion of demolition charges. Remainder of platoon reconnoiter the east bank of the RHEIN as far north as VALLENDAR; destroy the bridge from VALLENDAR to the island of NIEDERWERTH.

(3) REDEYE Sect. detail one team with each scout squad bridgehead on the RHEIN bridges; emplace the remaining teams to cover the MOSEL bridges.

(4) Antitank Pl. will emplace 5 squads in the area of A and B Coys and 1 squad with C. Co.

(a) 1st Tank Bn will be in reserve north of the MOSEL ready to counterattack any Red penetration.

(b) 20th Engr prepare demolitons to destroy each bridge across the MOSEL and RHEIN Rivers in the Bn area; supervise emplacement of barrier minefields and blow craters/building rubble across straight stretches of roads and RR tracks; prepare demolitons in buildings near to and NW of the FEBA, to be detonated if entered or used as cover by the enemy, or on orders.

3. Plan of Operations

a. Organization for Combat
1st Bn, 71st Infantry
HHC, 1st Bn, 71st Infantry
A Co., 1st Bn
B Co., 1st Bn
C Co., 1st Bn
Cbt Supt Co., 1st Bn
A Trp., 1st Sqdrn., 21st Armored Cav.

b. Blue Operations Overlay
(See Overlay B1)

4. Support Fire Plan
(See Appendix)

C. RED FORCE OPERATIONS PLANNING

1. Analysis of Situation

Following orders from 38th Div (0108, 2300), the Commander, 278th, prepared to resume his march on KOBLENZ. With receipt of orders at 2300 hrs., lead elements of 278th could be underway by 2330 hrs., expecting to reach the outskirts of northern KOBLENZ by approximately 0330 hrs. However, the available maps (KOBLENZ 1/25,000) and the limited stereo photographic coverage available to Co. 278th provides only spotty information on the best avenues of approach into the MOSEL bridges.

There appear to be three principal options for avenues of approach: (1) a center route, directly following Route 9 and paralleled through northern KOBLENZ by a railroad; (2) a partially open route on the right, providing the shortest and most direct approach to the bridges (and possibly even a hasty, direct river crossing of the MOSEL into KOBLENZ proper); or, (3) a long route on the left, through intermittant heavily structured areas, but with considerable flank security provided by the RHINE.

Co. 278th feels that only local reconnaissance can determine the nature and severity of terrain conditions on the alternate routes; further, disposition of potential enemy forces astride the avenues of approach is unknown. As a result, Co. 278th determines the following:

(i) Departure from the holding area will be delayed until 0400 to afford an approach to the outskirts of KOBLENZ during daylight hours.
(ii) Initial avenue of approach will be directly along Route 9

2. Unit Tasks

1st Bn. 278th is designated 1st Echelon with 1st TK Co., 278th Med Tk Bn attached. 1st Echelon will advance on the axis of Route 9 to contact with enemy, attempting to make a rapid penetration and seize the approaches to the bridges crossing the MOSEL.

2nd Bn. 278th is assigned 2nd Echelon. Upon contact by 1st Bn, 2nd Bn will deploy forward in the march column and be prepared to attack from the march on orders.

278th Medium Tank Bn is assigned 2nd Echelon. Upon contact by 1st Bn, 278th Tk Bn will bypass units in column and deploy in the vicinity of 278th Regimental Hq. (immediately following 1st Echelon) and be prepared to join 2nd Bn in attack from the march.

3rd Bn, 278th is assigned 3rd Echelon with responsibility to provide column rear security.

Security Plt (Recon Plt), 278th HHC will provide recommaissance and flank security along the west bank of the RHEIN, following local/secondary roads.

3. Plan of Operations

a. Organization for Combat (See Figure 1).
b. Order of March (See Figure 2).

4. Support Fire Plan
(See Overlay)

D. SITUATION ANALYSIS

The Red 278th Mech. Inf. Regt. has assigned a single axis of advance, Route 9, for its move south out of the RHEIN brdigehead area. Although on a parallel route with 280th Mech. Inf. Regt., the 278th, as 2nd Echelon, is judged to trail the 280th in time, since it must be prepared for direct (2nd wave) support of (through) the 280th. After release from its contingent mission of support of 280th, the 278th has a direct, dual mission: seize the bridges across the MOSEL River at KOBLENZ and the railroad nexus in that city; and protect the 38th Divisions east (left) flank during the march to the MOSEL.

Following the night march, as the 278th's point passes URMITZ-BANHOF (93-84), they are assumed to be sighted by the BLUE Brigade outpost on Hill 119 (96-84). The BLUE Brigade outpost consists of 3c/21 Armd. Cav. Sqdn; it opens fire at 1500m - 2000m range, thus altering both Red Force and Blue Force to impending action. The outpost withdraws as it is acquired by Red and draws return fire. Time: 0830 hrs., 0109.

Through most of the area from point of initial sighting into KOBLENZ, both Route 9 and the paralleling railroad are built on Hill 1m - 2m high. This will tend to slow and restrict Red's 1st Echelon in attempting to deploy off Route 9. Hence, a straight-in advance is attempted by advance elements of 1st Echelon (1st Co., 1st Bn.). Further, 1st Echelon cannot deploy right until well past the intersection, which is sharply cut into Hill 119.

Blue 1st Bn. has organized a defensive position which is heavily weighted toward platoon strongpoint defense of the center (Route 9/railroad) avenue of approach. This, together with a strong fire support plan will force Red 1-278 to slide left toward the protective screening of the outer-most line of factory buildings, and also will deny Red 1-278 the momentum to attempt a rapid penetration down the center avenue of approach.

At the end of Phase I the situation is judged to be as follows:

(i) Red 1-278 has developed full contact along the center and (his) left.
(ii) Red situation is as shown in Overlay R1.
(iii) Forward elements - including principal firing positions - of Blue defensive positions are disclosed.
(iv) All Red units remain effective.
(v) All Blue units remain effective.
(vi) End of Phase time: 1230 hrs., 0109.

PART 3: PHASE II
ATTACK FROM THE MARCH/DEFENSE

A. GENERAL SITUATION

1. General
2. Blue Sitrep
3. Red Sitrep

B. BLUE FORCE OPERATIONS PLANNING

1. Analysis of Situation
2. Unit Tasks
3. Plan of Operations
   (Continuation of Phase I)
4. Support Fire Plan
   (Continuation of Phase I)

C. RED FORCE OPERATIONS PLANNING

1. Analysis of Situation
2. Unit Tasks
3. Plan of Operations
   a. Organization for Combat
   b. Operations Overlay
4. Support Fire Plan

D. ANALYSIS

1. Main Attack
2. Supporting Attack

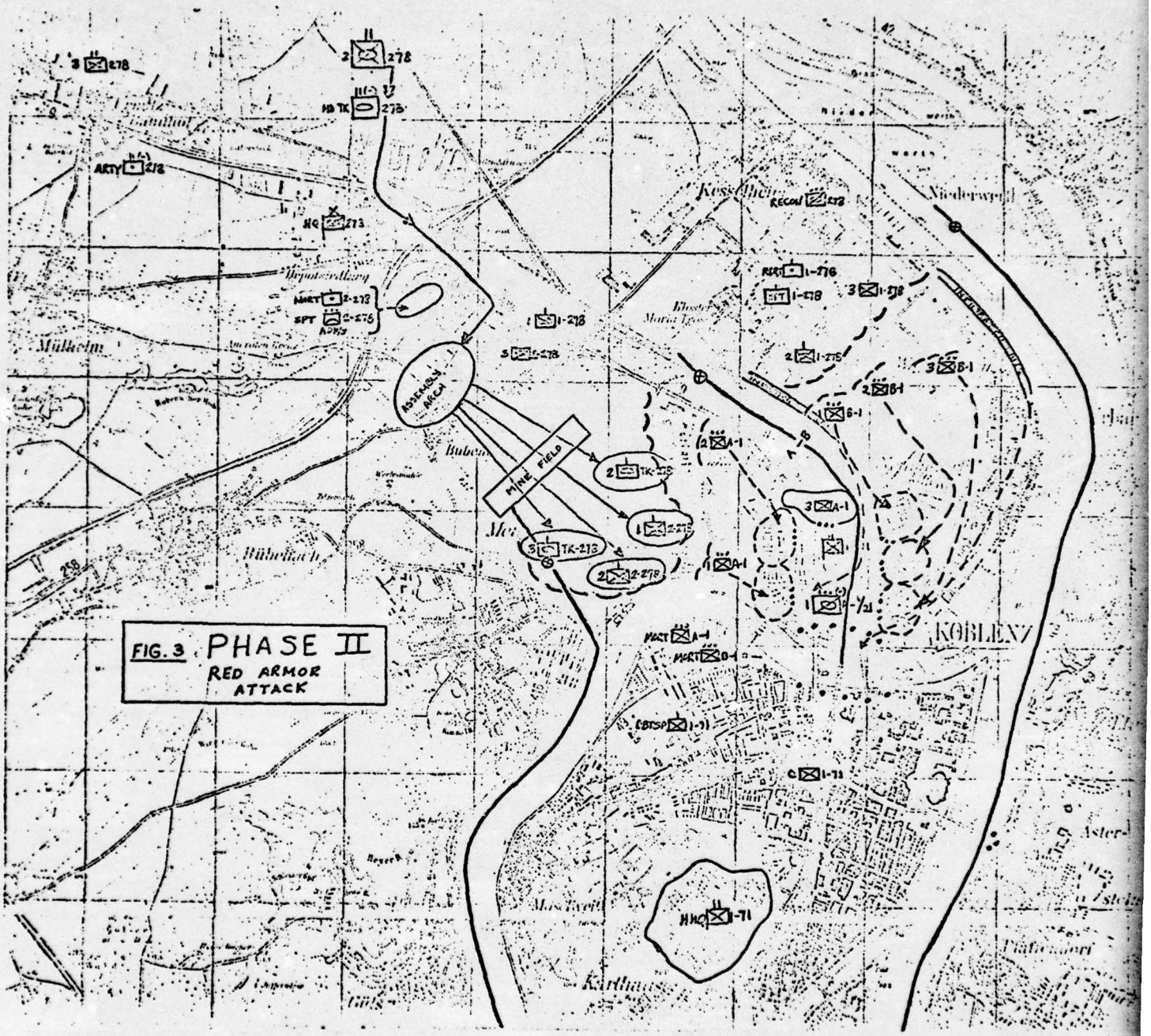


FIG. 3 PHASE II
RED ARMOR
ATTACK
MINE FIELD
ASSEMBLY AREA
KOBLENZ
Mülheim
Niederwerth
Karthause

A. INITIAL SITUATION

1. General

Situation is that existing at end of Phase I; time is now 1400 hrs. 0109. Commander, Red 38th Mech. Inf. Div. exhorts 278th Commander to mount an immediate attack to secure the MOSEL bridges. Blue Force Commander (1st Bn, 71st) directs A and B Companies to hold present position.

2. Blue Sitrep

CONTROL to Blue
Period Covered date 0800 - date 1400

Sitrep No. 2
May Ref: KOBLENZ Quad, 1/25000

a. Enemy

(1) Units in contact
Enemy advance guard of tanks and mechanized infantry attacked astride Route 9. Elements of Bn in contact.

(2) Known enemy reserves
Expected regiment follows lead bn

(3) Enemy activity
Hightailed through Cloverleaf, took positions astride Route 9, extended flank to KESSELHEIM. Using light mortar and small arms, fire, occasional missiles impacting among buildings.

(4) Estimated strength
Mechanized regiment plus tanks

(5) Courses of Action
Must attack to capture bridges; may mount a hasty attack this afternoon or try night attack.

b. Own Situation

(1) Location of forward elements. See Overlay B1

(2) Location of units, Hq and boundaries.
Same

(3) Location of adjacent and supporting tips
Same

(4) Own operations
After warning by C troop 21 Armored Cav Sqdn, were prepared to fire AT missiles when tanks and APCs appeared. Inflicted heavy losses, 3 afire, 1 blown up.

(5) Noneffective units
NONE

c. General
Enemy appears cautious, may have some concerted action plan with units attacking to the west.

d. Subordinates evaluation
We have an extended front, and a penetration could be serious. Could use more depth north of the MOSEL -- C Co. at least.

3. Red Sitrep

CONTROL to Red
Period Covered date 0800 - date 1400

Sitrep No. 2
Map Ref: NUWID-BENDORF-KOBLENZ -? Quad, 1/25000

a. Enemy

(1) Units in contact
Elements of 2 infantry bns

(2) Known enemy reserves - ?

(3) Enemy activity
Blue entronched along single track railline, METTERNICH-NUENDORF and industrial buildings along street between KESSELHEIM and WALLERSHEIM.

(4) Estimated strength - 2bns of infantry

(5) Courses of action
Enemy is holding strongly; not likely to withdrawn unless penetration to the MOSEL River endangers his route of withdrawal.

b. Own situation

(1) Location of forward elements. See Overlay R1.
(2) Location of units, Hq and boundaries. See Overlay R1.
(3) Location of adjacent and supporting tips. See Overlay R1.
(4) Own operations
Contact made 0830 hrs.; 1st Bn attacked from the March; now pressing fire contact from positions shown in overlap.
(5) Noneffective units
NONE

c. General
Bridges over MOSEL appear intact. Artillery fire coming from south, battery positions probably south of MOSEL River.

d. Subordinates evaluation
Enemy troops appear well trained. Need air strikes against enemy artillery.

B. BLUE FORCE OPERATIONS PLANNING

1. Analysis of Situation

The Red Force approach and initial contact has developed from the direction anticipated by Blue. The initial Red contact force of battalion plus strength made first contact on the Route 9 approach; subsequent development and threat deployment has established a line of contact on the battalion's center and right, principally in the B Co. area.

While the immediate contact force appears to be battalion-sized, Blue Commander estimates this to be only the first echelon (advance battalion) of an as-yet-undeployed regimental-sized unit of mechanized infantry. Further, Blue Commander estimates,

(i) Accepted threat doctrine suggests that a hastily mounted attack from the march may be expected within 3 to 5 hrs. Such attacks are conventionally mounted by a second echelon; most frequently they are mounted through the existing line of contact, although they may take the form of a flanking or encircling attack.
(ii) Current disposition of Red elements in contact develops a line running from battalion center to right flank; hence, estimates based on threat doctrine suggest likely directions of attack to be (first) along the Route 9/railroad corridor; (second) on the right through B Co. and driving on WALLERSHEIM; and, (third) an attack on the left through A Co. on the BUBENHEIM-METTERNICH road.

Considering these possible threats and the current situation, Blue Commander evaluates the situation as,

(i) Units of A Co. and B Co. are presently in the most advantageous positions to counter likely directions of attacks.
(ii) Currently, the enemy has not developed sufficient pressure to warrant immediate initiation of withdrawal to the secondary positions.
(iii) Current development of the situation does not warrant commitment or reposition of the reaction force.

As a result, Blue Commander elects to continue with original plan of defensive operations (Phase I). He issues a warning order to A Co. and B Co. appraising them of his estimate of the situation and warning of probable attack during the period 1630 hrs. to 1830 hrs.

2. Unit Tasks

Unchanged (See Phase I).

3. Plan of Operations

Unchanged (See Phase I).

4. Fire Support Plan

Unchanged (See Appendix 1 and Overlay B2)

C. RED FORCE OPERATIONS PLANNING

1. Analysis of Situation

a. Enemy

Blue infantry and mechanized cavalry occupy KOBLENZ suburbs north of the MOSEL River, probably a battalion plus from the Blue brigade reported in the area. Their morale is high, and they appear well trained, though probably inexperienced in combat. In the north and west side suburbs (KESSELHEIM-WALLERSHEIM) there are a number of industrial buildings (tilt-wall reinforced concrete) with open lots and parking between them; there also are tree nurseries, tall enough to conceal dismounted men, but not tanks or APC's. There appear to be rubble barriers and probably tank ditches on the avenues, and undoubtedly minefields. The RHEIN River on the left has a levee which prevents APCs from using the river to encircle the Blue position. No reserves have been sighted, but the MOSEL River bridges appear intact. Artillery fires seem to be coming from the south, possibly from positions on the high ground of the KOBLENZ peninsula.

b. Friendly

The 280th Mech. Rifle Regt. and 1st Med Tank Bn are attacking on our right. The division commander's concept of operations is for the division to close on the MOSEL, which would isolate any Blue defenders in KOBLENZ. The main thrust of the division will be toward GULS (96-79) and WINNINGEN (94-76), uncovering the Blue force in KOBLENZ, forcing them to withdraw precipitately. Our mission is to get across the MOSEL River, and to do it, we will put pressure on Blue so that when he tries to withdraw we can capture him/be in such close pursuit as to cross the bridges simultaneously before they can be destroyed. The 278th Mech Rifle Regt. will attack with battalions: 2d Mech Rifle Bn on the right with 278th Med Tk Bn attached will conduct a mounted attack across the open field and secure a lodgement (toehold) in the enemy position along the edge of town; the 3d Mech Rifle Bn on the left, will pin down the enemy with fire, probe for a seam in the defense, make a dismounted penetration, hold the flanks of the penetration, and pass through engineer/infantry infiltration teams, to proceed quietly to the bridge sites, destroy bridge guards and defuze any demolitions. When the bridges are secure, the infiltration team(s) will fire 3 Red Starts; the 2nd Bn and Tank Bn will smash through the remaining enemy positions, cross the bridge and secure a bridgehead in KOBLENZ south of the MOSEL. Tentatively, the attack will begin at 1700, with the infiltration teams passing through the breach in the enemy lines after dark.

c. Inhabitants

All local inhabitants are unfriendly, descendants of the Nazi enemy of the Great Patriotic War. However, they appear to have fled to the hills upon the approach of our liberating army, and will not be a factor in this battle.

2. Unit Tasks

Main Task (1st Echelon): 2/278 Mech Rifle Regt. and 278 Med Tank Bn (attached) will make a mounted attack to seize a toehold in the edge of the town of METTERNICH in your zone (see Overlay Red #2). Bulldozer equipped tanks in each company will doze ramps to cross the RR roadway along the north edge of town. CONTINGENCY: If the enemy flees, pursue immediately; stay close and seize the bridges. If the enemy continues to hold in the buildings, consolidate positions and prepare to continue the attack to the west on the signal 3 Red Stars fired by our engineer infiltration team, notifying you that they have defuzed the bridge demolitions.

2nd Echelon: 3/278 Mech Rifle Regt. will pin down enemy forces in your zone (see Overlay Red 2) with fire and aggressive dismounted patrols to locate at least one gap in the enemy defenses. When (a) gap(s) is discovered, make a narrow, deep penetration and hold it open so 4 engineer-infantry teams can be infiltrated through the lines and penetrate to the 4 bridges across the MOSEL. The infantry will silently destroy any bridge guards, while the engineers will defuze any demolitions set to destroy the bridges. After the teams have penetrated through the enemy defense line, the attack by 3/278 will increase in tempo to freeze the defenders in position.

Engineer-Infantry Teams: 10 infantry volunteers per team will be selected for their strength, endurance, marksmanship and scouting ability; also 3 engineers with similar attributes plus expertise in demolitions and bomb disposal will be selected, and a lieutenant team leader appointed. The four teams will be injected through the gap after dark (2030 hrs.) date.

3rd Echelon: 1/278 (+) Mech Rifle Regt. now in contact with the enemy, will regroup after 2/278 and 3/278 pass through them. The battalion will be prepared to reinforce in either sector, clean up any bypassed centers of enemy resistance, or to cross over the MOSEL and seize the peninsula high ground south of KOBLENZ (98-78).

Regimental Artillery: Regimental artillery and attached direct support (122mm How) Bn (less AT Btry) will support the attack from current positions.

3. Plan of Operations

a. Organization for Combat
(See Figure 3)

b. Operations Overlay
(See Overlay R2)

4. Support Fire Plan
(See Overlay R3)

D. SITUATION ANALYSIS

1. Main Attack

The regimental commander's decision to attack from a position of direct contact with the enemy along different avenues of approach was taken because of the canalizing effect of cut and fill raillines and highways along the approaches to KOBLENZ. Nevertheless, the main attack by the 2d Mech Rifle Bn and attached 278th Med Tank Bn (less 1 company) was made as an attack from the march with elements organized as:

a. March order: 2/278 Med Tk-1/2-278 Mech Rifle Bn-3/278 Med Tk-2/278 Mech Rifle Bn-Spt Btry/2-278 Mech Rifle Bn-3/2-278 Mech Rifle Bn-Mort Btry/2-278 Mech Rifle Bn.

b. Company deployment release point: RR-autobahn crossing 600m NE cloverleaf.

c. Platoon deployment release points: crossings over multi-lane main road to KOBLENZ, halfway between cloverleaf and circle intersections (SE of cloverleaf).

d. Squad deployment release points: town of BUBENHEIM-road to circle intersection.

e. Battalion 1st ECHELON: 10 medium tanks on line (2/278 Med Tk Bn) followed by 9 APC on line (1/2-278 Mech Rifle Bn) on right; line of 10 tanks followed by 9 APC of 3/278 Med Tk Bn and 2/278 Mech Rifle Bn on the left.

f. Battalion 2d ECHELON: 3/2-278 Mech Rifle Bn, ready to exploit success or to clear by-passed enemy positions.

g. Mortar Btry and ADMG Pl in supporting positions adjacent to 1st Bn Mortar Pl positions.

The Red attacking force on the right should come under Blue AT fire soon after it passes the company deployment release point, and in the canalized area, would almost have to employ smoke cover. It should cross the BUBENHEIM-circle rd jct-KESSELHEIM road deployed in successive lines (waves) of tanks and APC, under general fire of Blue defenders, whereupon it must transit the antitank/antipersonnel minefield covering its whole attack frontage. If the armored elements cross the open field, they will come to the single track railline -- Blue FEBA -- where they will be (examining stereo pairs) in hull defilade but with very limited crossing points.

a. Option 1: Red mounted armored attack breaks through Blue defensive crust and either reorganizes pending success of infiltration team(s) or smashes to river, races for bridge. Given no losses prior to passing through the line of contact, Red sends successive waves of 20 tanks, 18 APC and 9 APC + 6 AT weapons mounted on/towed by APC, on a frontage of 1700 meters. Probably no more than two of the battalion AT weapon, TOW, nor four platoon AT weapons, DRAGON, could fire on the 53 Red armored vehicles, which would require an extremely fast sequence of kills in a very short time to halt/defeat the attack.

b. Option 2: Several Red armored vehicles defeated at the canalized points (company, platoon deployment narrow passages, exists from streets of BUBENHEIM), plus slow movement/losses in the minefield, cause Red to halt his mounted attack, fall back line of departure area.

c. Option 3: Limited Blue AT fire and minefield exact a toll of Red armored elements, but still capable forces penetrate Blue FEBA in 1st Plt, Co A area. Blue drops back into "city ambush" configurations, where crooked/deaded/T-junction streets and durable structures negate Red Ripsnorter missiles below minimum range, tend to make mechanized infantry advance in dismounted formations, possibly putting armored vehicles in chancery to overhead, underground and side-alley attacks.

In suburban areas, there is often enough open ground/wide streets and garden-lawn surrounded homes so that the tank-antitank confrontation resembles open warfare. Against a tank force, Blue infantry might require either a very large number of tank defeating weapons (as the Egyptian Army used in the 1973 October/Yom Kippur War), or a few weapons with a super-quick load-aim-fire-impact time.

For the initial map exercise, CONTROL selects Option 3 for continuation of the exercises.

2. Supporting Attack

CO 1st Mech Bn postulated that the railyard was probably a Blue boundary, as was the RHEIN River and possibly the road from KESSELHEIM to WALLERSHEIM through the industrial area. He did not relish fighting his way through those heavy, fortress-like buildings, however, and decided to concentrate on slipping by the left (river) flank and down the right (railroad), where the high bank on the southwest edge of the railyard provided protection for one flank.

He noticed that along the riverside of the INDUSTRIEHAFEN (00-84/5) there were water level beaches where amphibious APCs could make a landing and nearly enfilade Blue defenses, covering a penetration along the water line by infiltrators. The nearest point that APCs could enter the river was at ST. SEBASTIAN (97-87), about 2.8km from the beach area alongside the industrial river port. He estimated the rate of flow of the RHEIN at 6 kts, which meant it would take approximately 3 hours 9 minutes for the APCs to swim upstream to their landing point. He decided to embark two infiltration teams (1 officer and 13 men each) at H hour (1700) in 4 APC (each with driver, alternate driver/machine gunner and 4-missile RIPSNORTER internal launchers and operator-gunner. The flotilla should beach at 2009, in nautircal twilight and 21 minutes before darkness. The remaining two infiltration teams were held at the Bn OP, to be dispatched in 2030 hours through any gap discovered (or down the tracks even without a gap, as the deputy cmdr for Political Affairs firmly suggested).

In the pinning attack, the aggressive dismounted patrolling was inconclusive; several subunits entered industrial buildings and structures south and east of the Maria Trost Convent, but no breakthroughs were reported. The APC flotilla, hugging in west-bank levee, did not come under fire till it passed the entrance to the INDUSTRIEHAFEN at 1956, and by 2000, a Blue AT missile launcher was in action on the beach side of the seawall; it was taken under fire by the APC machine guns and silenced.

The two river flank infiltration teams successfully penetrated past the Blue defended area and entered WALLERSHEIM, with a march of 3.9 km to the nearest low level bridge, about an hours march if not interferred with.

The two infiltration teams seeking to penetrate via the railroad split up -- one (Team #3) trying to crawl, Team #4 trying to race past riding 3 powered handcars on the multiple tracks.

a. a. Option 1: Team #1 reaches the BALDUINBRUCKE (low level highway bridge)

(1) *undetected, the assault group surprises Blue defenders and*
(2) the engineers find and sever wires leading to explosive charges or
(3) team is intercepted on bridge, a firefight ensues.

b. Option 2: Team #2 moves on to the high level vehicular bridge, but must climb up to bridge floor; requiring an additional 30 minutes beyond Team #1 action; if the latter is intercepted, an alarm will be sounded and Team #2 will probably be caught too; otherwise the same chance exists for surprising the guards and defuzing the charges.

c. Option 3: Team #3 faces an extremely difficult and slow initial infiltration by crawling. It can be aided or hurt by the action of Team #4 -- the noise and confusion attendant on the handcar attempt could mask their crawl, or Blue might illuminate the railyard and discover the crawlers as well as the handcar intruders. Once past the Blue FEBA, Team #3 has a reasonable chance of reaching a bridge.

d. Option 4: The handcar attempt may succeed if the noise of their vehicles is masked by battle noises until they burst through the Blue FEBA. They face three other obstacles: mines in the area in front of the Blue FEBA (not discovered and removed/detonated during the patrolling attack); being shunted onto a dead end siding in the railyard; and running into the Blue armored platoon reserve, alerted by the handcars' passge.

A flank with a seawall/levee must be covered to prevent an audacious enemy from enveloping that flank by amphibious craft and/or underwater teams. Multiple track raillines must be either blocked, mined or rails removed to prevent railroad rolling stock being used by the enemy to make a high speed penetration.

For the initial map exercise, CONTROL selects Option #1 succeeding, so that at about 2200 hours 3 Red Stars are fired in the air. (It is assumed that Team #2 was intercepted by elements of the Blue Tank Platoon; that of the hand cars (Team #4), one blew a mine, the second crashed into a standing freight car, and the third was switched into a dead-end siding; and Team #3 was picked up by Blue patrols searching for hand car survivors.)

PART 4: PHASE III
CONTINUATION OF ATTACK/DEFENSE

A. INITIAL SITUATION

1. General
2. Blue Sitrep
3. Red Sitrep

B. BLUE FORCE OPERATIONS PLANNING

1. Analysis of Situation
2. Unit Tasks
3. Plan of Operations
   a. Organization for Combat
   b. Operations Overlay
4. Support Fire Plan
   a. Targets List
   b. Support Fire Overlay

C. RED FORCE OPERATIONS PLANNING

1. Analysis of Situation
2. Unit Tasks
3. Plan of Operations
   a. Organization for Combat
   b. Operations Overlay
4. Support Fire Overlay

D. ANALYSIS

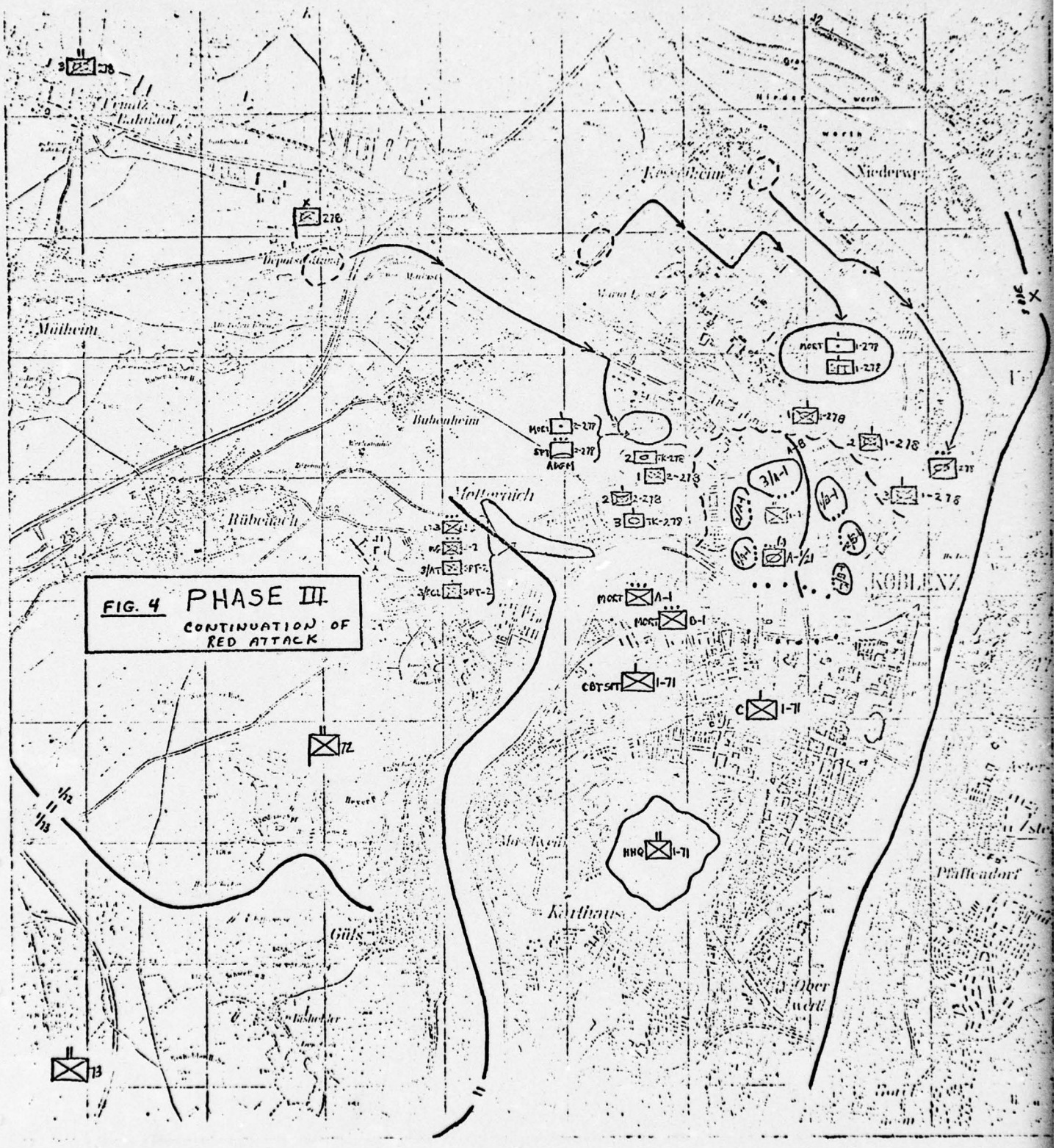


FIG. 4 PHASE III
CONTINUATION OF RED ATTACK

A. INITIAL SITUATION

1. General

Situation is continuation of situation at end of Phase II; time is 2400 hrs. 0109.

2. Blue Sitrep

CONTROL to Blue
Period Covered (Date) 1400-2400

Sitrep No. 3
Map Ref: KOBLENZ Quad & Stadtplan

a. Enemy

(1) Units in contact - Enemy mech regiment plus tank bn.
(2) Known enemy reserves - The advance guard battalion is probably now reorganized and in reserve.
(3) Enemy activity - Elements of tank and mech rifle bns made heavy mtd assault on A Co, closing to the railline. Minor infantry attacks on B Co line, but vigorous infiltration attempts along railyard and around right (RHEIN R) flank after nightfall.
(4) Estimated strength - Mech rifle regiment plus tank bn.
(5) Courses of action - Press the attack along BUBENHEIMER RD-MEYENER ST. toward bridges; mtd attack down railyard; mtd assault through WALLERSHEIM industrial region.

b. Own situation

(1) Location of forward elements
(See overlay Blue #3)
(2) Location of units, Hq and boundaries
(See overlay Blue #3)
(3) Location of adjacent and supporting trps
(See overlay Blue #3
(4) Own operations
1st and 2d platoons A Co withdrew into positions with built-up areas where enemy missiles less effective.
(5) Noneffective units
(Casualties not assessed, but could have been severe in breaking off the engagement and pulling back from railline.)

c. General
2A/73 and 1B/73, in railline salient, are exposed, and will be withdrawn to caserne areas. 3B/73 will withdrawn first.

d. Subordinates Evaluation
Battalion cannot afford to become immobilized, and must use buildings to screen movements, gain fire positions. Use of mines and overhead flamethrowers must be effective to hold north of MOSEL River.

3. Red Sitrep

CONTROL to Red
Period Covered (Date) 1400-2400

Sitrep No. 2
Map Ref: KOBLENZ Quad & Stadtplan

a. Enemy

(1) Units in contact - Elements of 2 infantry bns
(2) Known enemy reserves - Estimated bn in KOBLENZ
(3) Enemy activity
In area south and west of BUBENHEIMER Rd, enemy has withdrawn from railline into masonry buildings about 100-200 m from railline.
(4) Estimated strength
Casualties heavy. Enemy battalions estimated down to 600 men each.
(5) Courses of action
Hold in the built-up areas
Retreat south of the MOSEL -- possibly east of the RHEIN

b. Own situation

(1) Location of forward elements
(See Overlay Red #4)

(2) Location of units, Hq and boundaries
(See Overlay Red #4)

(3) Location of adjacent and supporting trps
(See Overlay Red #4)

(4) Own operations
2/278 Mech R. Bn and 278 Tank Bn attacking from a line of contact, closed on the railline (Overlay Red #3). Four penetration groups infiltrated enemy lines, and at least one team secured a bridge as of (date) 2200.

(5) Noneffective units
(No assessments made in Map Exercise; substantial fire casualties would have been incurred from mines, AT and artillery.) All bulldozer blade equipped tanks immobilized.

c. General
The enemy does not have enough AT weapons to stop a mounted attack with tanks. All operable tanks have rejoined 278 Tank Bn.

d. Subordinates Evaluation
278 Tank Bn Cmder. believes tank-led task forces can smash through to the KOBLENZ bridges, cut off the enemy in METTERNICH-WALLERSHEIM-NEUNENDORF and establish a bridgehead south of the MOSEL.

B. BLUE FORCE OPERATIONS PLANNING

1. Analysis of Situation

The battalion's initial delaying position was based on the embanked railline running from the Industrial Riverport on the RHEIN, and looping around LUTZEL to NETTERNICH, which provided an unrestricted field of fire for the western half of the defensive area. After Red had gained the railline in the A/73 sector, the bn cmdr pulled back into the city structures area, where line-of-sight, except along street axes, was severely reduced. The masonry buildings along the principle streets formed strong gun positions; a rifle company, with 18 rifle squad fire teams (plus 3 weapons squads, some headquarters personnel and battalion anti-tank squads located in the company area, could hold 18-20 small buildings, or some lesser number of large compartmented buildings -- with weapons squad members distributed with the fire teams in key areas. It was not necessary to hold every building -- only enough to enable armor or dismounted infantry to attack leaving a flank (side, overhead or underground) exposed.

An enemy breakthrough in the A/73 area, particularly through the shortest route to the MOSEL River (from the cemetery along BUBENHEIMER Rd. or WELLINGS Rd., and thence east along MAYENER St., or east through the sports fields area north of EIFEL St. (the topographic map and aerial photo stereoscopic pairs indicated a series of small suburban buildings -- the new street map calls it small garden areas) could split A Co., cut off B Co. from the bridges and endanger the mission. To prevent this, Blue bn cmdr was prepared to fall back into a single contiguous perimeter encorporating the FALCKENSTEIN KASERNE-RHEIN KASERNE, and running to the MOSEL River from the Upper Harbor to the inner riverport SE of the intersection of NEUENDORFER and STRASSBURGER Sts. This compact position would occupy the most strongly built, contiguous structures area in the suburbs north of the MOSEL, and while it would allow enemy artillery and mortars to set up within range of the bridges, gave the battalion positions from which to inflict serious losses on the enemy.

Blue bn cmdr alerted B Co. to be ready to swing back to the RHEIN KASERNE and buildings south of WALLERSHEIMER Rd. to the inner harbor, moving from the right flank left to the center. He cautioned A Co. cmdr to be especially alert for an attempt to split his front line along EIFEL St. If ordered to withdraw, he was to hold along MEYENER St. and allow 2A/73 to fall back initially to Falckenstein Kaserne; 3A/73 would cover the withdrawal of 2A/73, and 1B/73, then drop back into the buildings south of the cemetery and Volkspark.

a. Blue countermeasures against the Night attack
Blue battalion commander, from his OP on the nose above the railyard (A Co. reserve platoon area) when informed of the 3 Red Star flares fired behind him, immediately called company commander C Co. to direct increased alertness by the bridge patrol and an immediate check, since several Red infiltration attempts had been discovered and thwarted.

As the bn cmdr finished his conversation with C Co. cmdr, he could hear tanks to the west, heavy firing could be heard in the 1A/73 Inf area near the cemetery and BUBENHEIMER Rd. In the area of 2A/73 Inf. small arms fire could be heard, but no sounds of armor. Overhead illumination shell bursts began illuminating the area.

A quick call to B Company reassured him that the same probing attacks that had been turned back during the afternoon were again underway. He directed 3A/1 Tank to take positions to counter the enemy tank attack expected to push down BUBENHEIMER Rd., and to use the flicker technique when illuminating enemy armor with their Xenon searchlights.

2. Unit Tasks

A/73 hold initially in present positions; prepare to withdraw on command: 1st Plt. via MAYENER STRASSE, 2nd Plt via VOLKS-KUHL STRASSE toward prepared positions in FALCKENSTEIN-KASERNE area. 3rd Plt. will cover withdrawal, then fall back assigned secondary position.

B/73 hold initially in present positions; prepare to withdraw on command: 1st Plt. via railroad to RHINE-KASERNE area, 2nd Plt. via direct route to south WALLERSHEIMER Rd. area, 3rd Plt via WALLERSHEIMER Rd. to south harbor area. 1st Plt; 3rd Plt A Co. will cover withdrawal of 1st Plt. 1A/21 Armd Cav will immediately proceed on MAYENER STRASSE to counter armored attack in 1st Plt A Co. area.

C/73 will clear MOSEL bridges of infiltrators.

3. Plan of Operations
Unchanged (See Phase I)

4. Support Fire Plan
Unchanged (See Appendix 1)

C. RED FORCE PLANNING OPERATIONS

1. Analysis of Situation

Aggressor stresses rhythm and mementum of attack; this includes continuation of the attack at night. Aggressor doctrine also prescribes illumination at night, with increasing levels of brightness as the distance between opponents closes (this is interpreted to mean illumination is used if it is advantageous to Aggressor; they would not be expected to illuminate a night infiltration effort). It is noted that armored vehicles have powerful searchlights, which may be used in white light or IR mode. In open country, moving vehicles using white light illumination are very difficult to target with infantry small arms, since there is no reference for aiming, whereas IR sights tend to induce zeroing-in the aims of fairers. Within a city, the geometry of buildings and streets restores references for aiming, particularly if counter-illumination by flickering light sources from different locations is used.

a. Red Night attack considerations
Penetration Routes for Armored Vehicles: In the area of 2/278 Mech R Bn and 1/278 Tank Bn (-), there are six streets that could be used;

(1) Route 9 highway from the cloverleaf, which curves south (Bonner St) to cross the high bridge;
(2) the street that splits off just east of the Rasthaus and curves south next to the railyard (Andernacher St.);
(3) an additional split-off road (Bodelschwingh St.) between the first two;
(4) a turn-off of Rt 9 west of the Rasthaus southward (In der Rothenlange-Johannes St.) where it joins Mayener St.; and
(5) BUBENHEIMER Rd. and
(6) the roads that split westward through the center of METTERNICH to GULS, (Rubenacher-Trierer Sts.). All of these roads, with some convolutions, end up leading to the BLADUIN and new MOSEL bridges.

Formations for Continuing the Attack: Basically, the 2/278 Mech R. Bn (+) can try either a mounted or dismounted night attack. A mounted attack would try to push down one or more of the penetration routes listed above, while a dismounted attack could try to break open a route through any or all parts of the built-up area. It might be necessary to use dismounted infantry to push the enemy away from barriers to permit mine-clearing, rubble removal/ditch filling before a mounted attack could proceed. The regimental commander stressed that "speed is essential to secure a bridge before it can be blown up; just to push the enemy back so he can escape across the bridges and then demolish them is not enought."

The 2d Bn commander had decided that if the 3-Red Start signal appeared, his best chance of reaching the bridge was via the shortest distance -- on the Bubenheimer (Rt 258) Road, but he realized this route would undoubtedly be mined, cratered and strongly defended. He directed that a task force under company commander B/278 Med Tk, consisting of 3B/278 Tk platoon and 3D/278 Mech R. Plt, would attack mounted from the cemetery directly down BUBENHEIMER Rd. MAYENER St. to the Rt. 9 bridge approach, and be prepared to seize any or all three vehicle and RR bridges.

2D/278 Mech R and 2B/278 Tk would cross the railroad line, attacking south to RUBENACHER St., turn east on RUBENACHER-TRIERER St. to its junctuie with MAYENER St., and follow up the 3d Platoon's Task Force. 1D/278 Mech R. and 1B/278 Tk would attack south, parallel to 2d Platoon's Task Force, move east to the RUBENACHER-TRIERER Rd. junction and block eastward movement of any Blue reinforcements through METTERNICH. (See Overlay Red #3). Special Instructions:

(a) 3B/278 Tk platoon will have two bulldozer tanks to clear rubble and fill-in tank ditches;
(b) When the lead tank reaches a tank obstacle, its APC partner will dismount troops and protect the vehicles from enemy AT fire;
(c) Following APC will turn right at the nearest cross street and attempt to bypass the barrier;
(d) The third APC will turn left at the nearest cross street and attempt to bypass the barrier;
(e) If either bypass attempt is successful, the APC will continue the mission, signalling the partner tank to follow and catch up.

In the sector north of the BUBENHEIMER Rd., the RR track fill is high, and east of the track are a series of massive industrial buildings, parking areas, and ill-defined streets. Bn commander decided to dismount E/278 Mech R. and attack all along the company front, with tanks and APCs providing covering fire from defilade behind the RR track. As soon as the riflemen broke through the Blue defenses, C/278 Tk Bn would cross the RR at prepared passage points, and gain the north-south road, phase line A (Overlay Red #3). If B/278 Tks and D/278 Mech R had not broken through Blue defenses, C/278 Tk would move south, then east on Mayener St. and seize the bridge; if the Task Forces had broken through, C/278 would move north to Rt 9, then east and south on the three penetration routes to seize the bridge(s) and block the escape of any enemy to the south bank of MOSEL River. He directed the bn reserve F/278 Mech R and 1A/278 Tk to be prepared to exploit success or pass through a stalled unit on order.

The regimental commander ordered 3/278 Mech R to continue the holding attack in the sector north and east of the RR switchyard and 1/278 Mech R (+) to be prepared to follow 2/278 (+) Mech R and cross the MOSEL.

2. Unit Tasks

2/278 continue line of attack to seize MOSEL bridges. 1/278 continue supporting attack. 3/278 hold present position.

3. Plan of Operations

a. Organization for combat
Unchanged except for internal platoon attack task force within 2/278 (See Analysis of Situation above).
b. Operations Overlay
(See Overlay R5)

4. Support Fire Plan
Unchanged

D. ANALYSIS

1. Outcome Options, (Main Effort)

Although only about 1/3 of Red B/278 Tk and D/278 Mech R attack in the area of Blue 1/73 Inf (the rest attack through the area of Blue 1/80 Inf), it is the key Red Task Force (3B/278 Tk and 3D/278 Mech R), trying to break through from the cemetery area, near the "crease" between Blue 1/73 and 1/80 Inf, directly down Rt 258 on the short run (1.5 km to the approach to the New MOSEL vehicular bridge, about another .6 km to the BALDUIN low level vehicular bridge). The remainder of the tank and mech rifle companies are directed to turn east and assist this task force, once they have penetrated Blue defenses. In the area of the elevated railroad track, there is some open ground north and east of the cemetery, allowing maneuver. The street passes through an area of modern, scattered high-rise buildings on the south side, then through separated older masonry buildings on both sides. Trees line the road; there is opportunity for armored vehicles to get off the road to either flank (and concommitant open space for defensive weapons to take an armored column in the flank. After the V junction with the road closely paralleling the MOSEL River (Rt 417?) the street is wider, but the structures lining it are closer together and nearer the street. The armored attack must be stopped between this road junction and the modified cloverleaf entry to the high bridge to maintain the security of the bridges.

In the zone of C/278 Tk and E/278 Mech R, once the elevated RR tracks are crossed, there is a fairly clear corridor running slightly north of east all the way to Rt 9, although it may not be apparent from the ground until past the screen of small houses 200m northwest of the soccer field.* Should the dismounted infantry break through and recognize this corridor, armored units could quickly reach the position of 3A/73, the reserve platoon, and once past them, have a straight path down BONNER St. to the high level New MOSEL bridge (1.3 km south).

NOTE: The new Stadtplan (road map) indicates the shaded area marked on the topographical map is a series of small gardens rather than small houses/buildings; however, this probably only means earlier recognition of a possible route, and a near perfect field of fire for the defenders.

a. Option #1: 3d Platoons task force (3B/278 Tk and 3D/278 Mech R) break along BUBENHEIMER Rd. - MAYENER St., are ambushed and counter attacked by Blue 3A/1 Tk from positions among buildings south of Maria Hill Church.

b. Option #2: 3d Platoons task force, meeting heavy opposition along BUBENHEIMER Rd, branches off ENE along EIFEL St., breaking through to the vicinity of the Southwest Broadcast Station/Tower, where they were halted by AT fire from Blue 3A/73 Inf and No. 4 and 5 tanks from 3A/1 Tk.

c. Option #3: 3d Platoons task force defeated on BUBENHEIMER Rd by mobile mines pulled in front of armored vehicles and roof-top flame thrower attacks.

d. Option #4: 3d Platoons task force halted on BUBENHEIMER Rd. under severe attack, when 2d Platoons task force (2D/278 Mech R and 2B/278 Tk) attack along Trierer St. Blue Tank platoon (3A/1 Tk) (less No. 4 and 5 tanks), in reserve, counterattack west along MEYENER St., driving Red 2d Platoons task force back down TRIERER St., until Red 1st Platoons task force (1D/278 Mech R and 1B/278 Tk) reinforce 2d task force, and stalemate occurs.

e. Option #5: E/278 Mech R. company, dismounted, tried to cross the railline with 3 platoons abreast (See Overlay Red #3). 1E/278, on the right, was pinned down in the sports fields, with heavy casualties from mortar fire. The 2d and 3d platoons in the center and left, took heavy casualties from defenders in the industrial buildings along the east side of FRIEDRICH-MOHR St. Supporting tanks fired 100mm guns to destroy the buildings, while APCs sprayed the area with MG fire; these immobile armored vehicles came under fire of Blue medium artillery, striking with uncanny accuracy along the railline (the static Red Armor was lined up on the gun-target axis, so that overs and shorts still hit targets), and finally forcing the surviving tanks and APCs to turn off their searchlights and withdraw, firing spasmodically while cruising about in the fields west of the Unbrako factory. The attack ended in stalemate.

f. Option #6: E/278 Mech R Company, dismounted, attacked across the railline with three platoons abreast. On the right, the 1st platoon was pinned down in the sports fields-garden area, but on the left, struck Blue defenders who were withdrawing east and southeast. The C/278 tanks and E/278 Mech R APCs were unable to cross the elevated railline because they had no bulldozer tanks to construct overpasses; Blue medium artillery struck along the railline, destroying several armored vehicles. 1C/278 tanks, moved south to the cemetery, and crossed behind 1 task force, then turned NE along EIFEL St. 2 and 3C/278 tanks moved north to BONNER St. (Rt. 9) and turned, in column, to drive east through the RR underpass. As the third tank reached the center of the underpass, ther was a violent explosion, and the overpass collapsed, blocking all passage along BONNER St. The two isolated tanks which had gotten through before the explosion, were taken under fire by AT missiles and disabled. No further mounted action was taken until engineers could blow/construct passages through/over the railline, and the attack stalled.

2. CONTROL Analysis

It appears desirable to define city battle and AT vs. tank engagements in built-up areas in terms of:

a. specific weapons (guided missiles-ballistic rounds) by ranges (i.e., down the line-of-sight length of street and cross-over from side alley/vacant lot in terms of min/max range, time to aim, fire, guide, reacquire a new
b. armored target;

b. Cratering of street pavement where contiguous buildings canalize traffic, before or during enemy attack;

c. Use of defended and undefended (but with sensors to call in high angle HE fire) barricades;

d. Entrapment of enemy vehicular detachments by barricades in front, craters/toppled buildings in rear;

e. Use of short-range, exact target, armor-lethal weapons from overhead, half-basement, or substreet level;

f. Mobile mines for short range attack against armor;

g. Mortar/artillery single gun shelling of intersections on call, or sensor/initiated; artillery TOT on buildings/bridges to destruct/block routes with rubble;

h. Means of immobilizing enemy armor in a predetermined area (water/emplaced barrier, blocked on an elevated highway) where large artillery shells can target them.

A peg-type 3-dimensional model of type city layouts (say radial, radial ring, ray, checkerboard, combined, random patternless -- as in Combat Action of a Motorized Rifle Battalion in a City, page 5), permitting changed patterns of buildings, roadblocks, rubble, etc. to be emplaced, and narrow light beam measurement of line-of-sight and range, would permit calculation of data to define city combat parameters.

For this map exercise, CONTROL selects Option #4 in the area of mounted attacks and Option #6 in the area of dismounted attacks of the main effort.

3. Secondary (Holding) Attack

In the zone of 3/278 Mech R., the holding attack is unlikely to influence the outcome unless penetrations down Rt 258 or Rt 9 give the appearance of success, and the Blue forces opposed to 3/278 Mech R. are ordered to withdraw, or panic and retreat. In such case, vigorous exploration could bring the force to the BALDUIN and RR bridges (down the tracks or the streets north and east of the railyard), although the distance (about 3 km) is greater than the 2/278 Mech R units must advance.

Captain of Blue B1/73 felt that withdrawal across the mostly empty lots from the railline to Werner-von-Siemans street, and the long distance for his right flank platoon, would endanger a successful disengagement. He requested battalion for any available 3/4 and 1/4 ton trucks, so that he could withdraw suddenly and swiftly to the RHEIN CASERNE. His plan was to withdraw 3B (right flank) first; 1B (left flank) second and in coordination with the withdrawal of 2A1/73; and 2B (center) last, covering the withdrawal of the more exposed platoons.

Blue B Co. cmder wanted 3-jeep mtd strike teams per platoon, with the regular rifleman driver, machine gunner and Dragon gunner in each. The strike teams were pulled out of the line first, to get sorted out and ready to cover the hasty withdrawal of the rest of the platoon in 3/4 T trucks. FPL fire was to be laid in front of platoon positions to discourage an enemy advance, and mines were to be emplaced and smoke released while the withdrawal was in progress, to slow down pursuit. The battalion commander approved the plan, sent the vehicles to B Co. and ordered the regrouping to begin at the same time that the reserve tanks were ordered to move.

4. Outcome Options, Night Holding Attack

a. Option #1: B1/73 withdraws as scheduled, since Red's holding attack was not pressed, and no pursuit was initiated.

b. Option #2: 3B pulled out successfully, but the Red APCs on the RHEIN beaches next to the INDUSTRIEHAFEN noticed Blue direct fire had stopped, speculated Blue defender was moving. Red 3/278 Mech R elements pushed forward just as Blue 1B platoon was pulling back, as was Blue 2A platoon. B Co's strike teams, moving rapidly and utilizing the smoke and final protective line high angle fires, discouraged the cautious Red dismounted attack, and in the Blue 2d platoon area, Red attackers were caught under the full platoon's fire.

c. Option #3: 3B pulled out successfully, but the Red APCs on the RHEIN beaches next to the INDUSTRIEHAFEN noticed Blue direct fire had stopped, speculated Blue defender was moving. One APC moved forward to test the Blue reaction, and when no response was made, radioed Red battalion urging a mounted attack around the left (RHEIN River) flank, but inland from the INDUSTRIEHAFEN. 3/278 Mech R. bn cmdr immediately ordered up H Co APCs and mounted the company; he directed the dismounted infantrymen in the Kapal buildings to attack at once and clear a route down HANS BECKLER St. for the APCs. The mounted force pressed forward through WALLERSHEIM, following WALLERSHEIMER Rd. passed HERBERICH St. before meeting any opposition. By this time the rest of the battalion was mounted and following H Co., and the column smashed through to the BALDUIN Bridge. The Blue bridge guards blew up the BALDUIN and RR bridges, and the attack was stalemated.

d. Option #4: 3 B pulled out successfully, but the Red APCs on the RHEIN beaches next to the INDUSTRIEHAFEN noticed Blue direct fire had stopped, speculated Blue defender was moving. Upon receipt of this intelligence, Red 3d Bn cmdr. directed an immediate assault all along his line. I Co, on the left (RHEIN River) flank, smashed through the gap created by Blue's right flank withdrawal, and encircled the center of Blue's (B Co) line. The regt'l cmdr ordered his reserve, 1/278 Mech R plus 2 tank platoons, to exploit the gap. Racing quickly down HANS BOCKLER St. and WALLERSHEIMER Rd., the tanks smashed through the defenses across the defused demolitions on the BALDUIN Bridge and established a bridgehead south of the MOSEL River.

5. CONTROL Analysis

A night withdrawal under pressure is one of the most difficult of military operations, particularly at the small unit level. Careful preplanning is essential (but carries with it the danger of weakening troop resolve to defend tenaciously). Like a relief in position, an advance detachment must stake-out the new position, and guide withdrawing troops quickly to their alloted positions.

It seems appropriate, in defending a heavily built up city, to plan and mark-out a whole series of defensive alignments, and to condition the small units to the concept of a real mobile defense, using all-level routes of movement (rooftop, subsurface, and motorized/mechanized fast travel on surface streets and elevated roadways. It may be useful to organize and train Hunter-Killer teams, to range through the unoccupied areas, and attack small enemy formations. Such teams would need a short-range, exact target (camera style range-finder sight) weapon with armor defeating, anti-personnel grape shot and wall-breaching rounds; a silenced slow rate machinegun, hand grenade/ "knee mortar" lob fire weapon; and a quiet, electric motor, lightweight transporter.

For the map exercise, CONTROL selects Option #2, and ends the night attack phase in a stalemate, or continued successful defense north of the MOSEL River.

PART 5: PHASE IV
AIRMOBILE ASSAULT/DEFENSE

A. INITIAL SITUATION

1. General
2. Blue Sitrep
3. Red Sitrep

B. BLUE FORCE OPERATIONS PLANNING

1. Analysis of Situation
2. Unit Tasks
3. Plan of Operations
   a. Organization for Combat
   b. Operations Overlay
4. Support Fire Plan
   (Continuation of Phase I)

C. RED FORCE OPERATIONS

1. Analysis of Situation
2. Unit Tasks
3. Plan of Operations
   a. Organization for Combat
   b. *Operations Overlay*
4. Support Fire Plan
   a. Targets List
   b. Support Fire Overlay

D. ANALYSIS

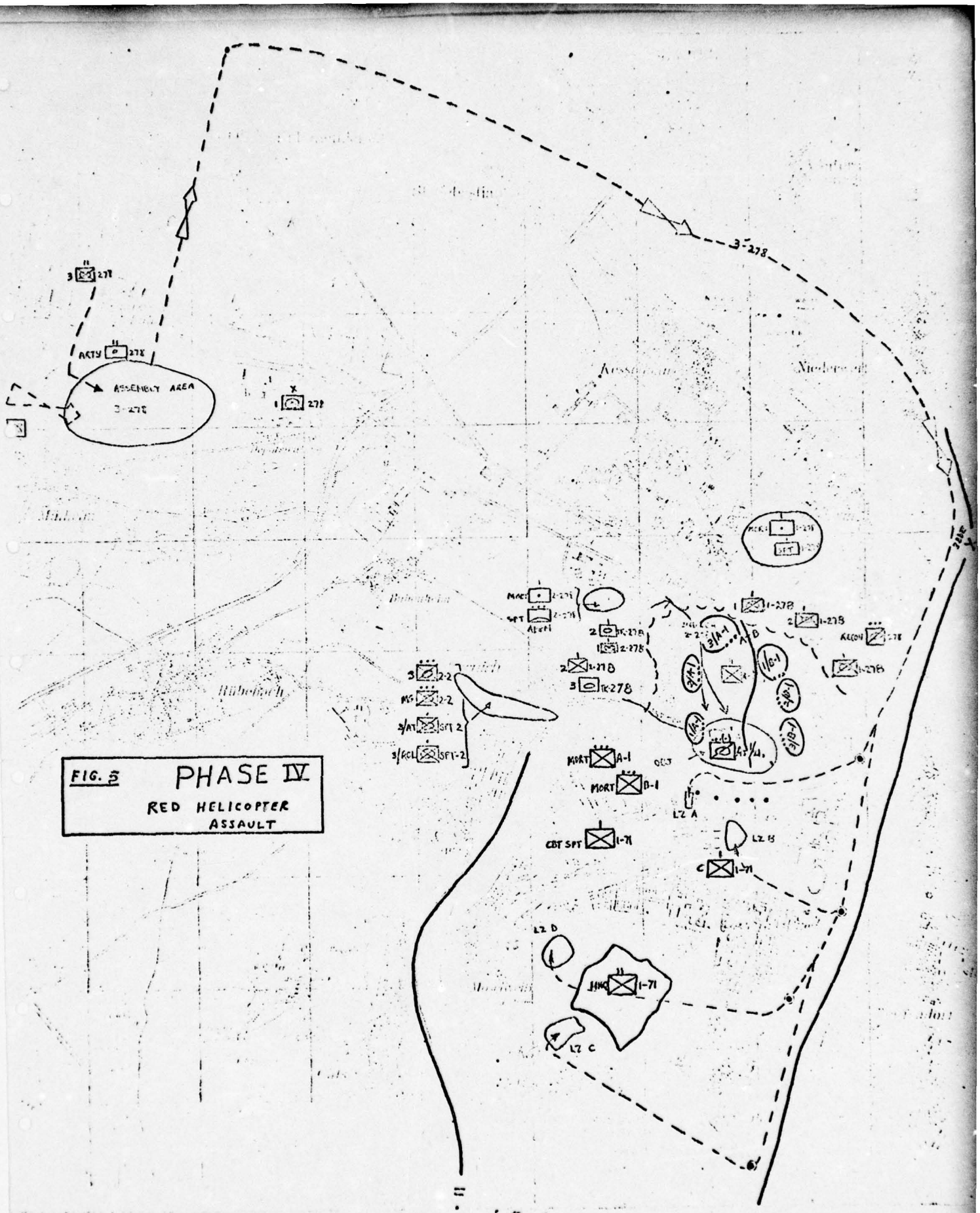


FIG. 5 PHASE IV
RED HELICOPTER ASSAULT

A. INITIAL SITUATION

1. General

Situation is that of conclusion of Phase III; time is 0115, 0110.

2. Blue Sitrep

CONTROL to Blue
Period Covered 2400 (next day date) 0115

Sitrep No. 3
Map Ref: KOBLENZ Quad & Stadtplan

a. Enemy

(1) Units in contact
Elements of mechanized regiment plus tank battalion.

(2) Known enemy reserves
3d Mech Rifle battalion.

(3) Enemy activity
Enemy made a determined mounted thrust down MAYENER Street; dismtd infantry attacked through KLEINGARTEN area west of In der ROTHENLANGE Street; tank attack east on BONNER St. stopped by blowing RR overpass onto leading elements. Light probing attacks in B Co. area.

(4) Estimated strength
2 battalion of mechanized infantry plus 1 tank battalion.

(5) Courses of action
It is no longer possible for the enemy forces in contact with us to capture the bridges intact by direct assault; he may attempt an airborne or amphibious/frogman operation.

b. Own Situation

(1) Location of forward elements
(See Overlay Blue #4)

(2) Location of units, Hq and boundaries
(See Overlay Blue #4)

(3) Location of adjacent and supporting trps
(See Overlay Blue #4)

(4) Own operations
Withdraw A and B companies and attached tank platoon into the two-Kaserne strongpoint. C Co alerted for possible air landings or frogmen moving in via seawall steps.

(5) Noneffective units
Not assessed.

c. General

The enemy can destroy the bridges across the MOSEL by artillery/mortar/direct tank gun fire, isolating A and B companies.

d. Subordinates Evaluation

The enemy has not fired on the bridges, leading to the assumption he will attempt an airborne or amphibious assault. If one starts, it appears prudent to withdraw A and B companies south of the MOSEL.

3. Red Sitrep

CONTROL to Red
Period Covered 2400 (next day date) 0115

Sitrep No. 3
Map Ref: KOBLENZ Quad & Stadtplan

a. Enemy

(1) Units in contact
Elements of 2 infantry bns

(2) Known enemy reserves
Estimated bn in KOBLENZ

(3) Enemy activity
Blue bn with attached tanks in the METTERNICH-WALLERSHEIM area withdrew to positions in the LUTZEL area, still covering the north bank of the MOSEL bridge approaches.

(4) Estimated strength
Remnants of a battalion of infantry plus a small tank unit.

(5) Courses of action
(a) Try to hold present small bridgehead
(b) Attempt to withdraw across bridges
(c) Blow up bridges, then surrender

b. Own Situation

(1) Location of forward elements
(See Overlay Red #6)

(2) Location of units, Hq and boundaries
(See Overlay Red #6)

(3) Location of adjacent and supporting trps
(See Overlay Red #6)

(4) Own operations
D/278 Mech R and B/278 Tks, organized in mixed platoon task forces, penetrated down MAYENER Street to Ad. Eisbreche, but were stopped by a concentration of movable mines; C/278 Tks lost 3 Tks in blown collapse of RR overpass over BONNER St.

(5) Noneffective units
Tank losses to B and C companies forced consolidation -- (no assessments made for Map Exercise).

c. General

The movable mines employed by the enemy require dismounted infantry attacks. We are not firing at the bridges so as not to accidently destroy them.

d. Subordinates Evaluation

It is possible that a quick air landing operation may secure the bridges, isolate the Blue defenses north of the MOSEL, and result in their destruction or surrender.

B. BLUE FORCE OPERATIONS PIANNING

1. Analysis of Situation

Red attacks in A Co. area have been successfully held off; B Co. area is not heavily threatened (the attack in B Co. area appears to be only a supporting attack, not aggressively pushed).

The enemy is now known to have approximately a Mech Rifle Bn in reserve. Possible modes of commitment of this reserve are of increasing concern to Co. 1/73:

(i) Commitment of enemy reserve can be anticipated with current enemy attacks stalled out.

(ii) Direct commitment options are restricted to attack through already committed units; presently committed units are operating in severely confined space. Thus, direct commitment of reserves seems highly questionable.

(iii) Accepted views of enemy doctrine envisions helicopter-borne operations to leap-frog assault units over strongly held built-up area strong points or river obstacles.

Commander 1/73 decides that direct commitment of enemy reserve battalion does not pose an immediate threat; the possibility of helicopter-borne operations - probably south of the MOSEL - requires special consideration of air defense capability in C Co. area.

South of the MOSEL, ground defense of KOBLENZ rested primarily on C 1/73, with a mobile assist from the scout platoon of the combat support company. However, BnXO felt the need for additional air defense against low flying fixed wing and rotary wing aircraft. In Hq & Hq Co. he had 14 50 Cal MG, HB flexible for ground use -- a mount unsuited to an air defense role. He wished he had three M-55 powered mounts, but still considered the cal 50 MGs could be useful in improvised air defense roles. He considered the following:

a. Replace the 7.62 MGs on the 8 scout section jeeps with 50 cal MGs (There is no information available on the scout jeeps, except a silhouette in the Infantry Reference Date; improved ball-pedestal mounts were used in WWII, with success claimed in war diary accounts).

b. Shackle the ground mount tripod to a wooden frame; set up 4 man MG team-gunner, loader, and two frame tilters to "lean" the frame out windows/over a roof top parapet at an angle calculated to hit an aircraft.

c. Since KOBLENZ is built partially on a steep-sided peninsular nose above two rivers, place MGs in tiers around possible aircraft targets/landing/drop zones, and conduct a dove shoot defense (the 50 cal has a max horizontal range of 6800 m, and effective ranges of 1800 m (ground) and 725 m (air)); the tripods could be shackled to truck cabs to give an added degree of semi-traverse and mobility (have the truck slowly turn in a circle to keep target aligned; drive to an emergency site; or head up/down a hill to help target the MG.

For the map exercise, BnXO decided to put the guns in tiers above both rivers, with fire in sustained bursts against enemy aircraft intruding into the tier and cone of fire of weapons.

As to the Redeye, it can be assumed that:

a. Only the 5 Redeye teams of team chief and gunner have been trained to fire the small missile (i.e., 10 prospective firers);

b. 10 men in Cbt Spt Hq Sec and 8 in the two scout sections have been trained to fire the missiles in one of the three training centers in West Germany (moving tgt simulator M87, the field handling trainer M46, and guided missile training set M76); or

c. In addition to the 18 Cbt Spt Co., alternate gunners, all mess team personnel (28) of the Bn Hq Support platoon have been Redeye qualified. It appears that in combat, each Redeye team truck could transport in excess of 100 shipping and storage containers. (1 missile sealed in the disposable launcher and 3 battery/coolant units -- weight about 29 pounds), so that the additional skill, secondary gunners could be supplied with 2-3 containers for emergency employment.

2. Unit Tasks

A/73 hold present position.
B/73 hold present position.
C/73 assure air defense readiness of Bn area south of MOSEL; prepare to counter possible helicopter-borne assaults south of MOSEL.

3. Plan of Operations

Unchanged

4. Support Fire Plan

Unchanged

C. RED FORCE OPERATIONS PLANNING

1. Analysis of Situation

At 0120 hours a report reached division that elements of the 278d Mech Rifle Regiment were within 1000-1500 meters of the bridge complexes across the MOSEL River, and that Blue defenders had not blown up any of the spans. Since the 273d was much closer to accomplishing its mission than any other units in the 38th Mechanized Rifle Division, the division commander considered how best to support that unit's operations.

Aggressor doctrine envisions helicopter-borne operations for river crossings by assault elements, for seizing important objectives inside a city, and for blocking enemy reserve movements or resupply operations, as well as emergency transport of critical items for Aggressor's own support. It seemed to the division commander that the situation was a classical example of the desirability of using helicopters for a tactical air landing: he had to cross a river and seize (an) important objective(s) in the city of KOBLENZ. At 0145 he called 273d Mech R. regimental commander and said helicopters to lift a battalion of dismounted troops would be placed at his disposal in 20 minutes, where did he want them to report? Division commander wanted a night tactical air landing operation to take Bue by surprise.

Regimental commander, with excellent hindsight, thought to himself how he wished the tactical air landing operation had been scheduled as a coordinated part of the initial assault, but aloud thanked the division commander and requested that the helicopters be flown to the open lots between the INDUSTRIEHAFEN and HANS BOCHLER Street, across from Kapal Plant #1 to pick up 1/273 Mech R. Bn (less APC platoon both vehicles and drivers, and 2 drivers of 5-ton wrecker and 4-ton shop van).

There was little time for an elaborate plan, and none for reconnaissance; however, the regimental and 1st Bn commanders had seen KOBLENZ for several hours of daylight the day before, and had both topographic and street maps of the area. A helicopter-transported operation was always impromptu, functioned on SOP and fragmentary verbal orders. It was a matter of picking objectives and the nearest useable landing zones. The regimental commander, commander 1/278 Mech R., and commanders of A,B,C companies and Mortar and Support Btrys assembled at the Kapal Plant #1 for issuance of orders at 0150 hours.

2. Unit Tasks

Mission: establish a bridgehead on the south bank of the MOSEL River covering the railroad and high and low level vehicular bridges, and defuze any prepared demolitions; establish a perimeter defense of the Karthaus (inner walled city?) in south central KOBLENZ and cover the RHEIN bridges and westside RR bridge across the MOSEL to Guls.

Objectives and LZs (See Overlay Red #5).

a. Objective 1: New MOSEL Bridge south approach system and south end of sluice (floodgate), LZ A-Jewish cemetery 150m west of high bridge.

b. Objective 2: RR and BALDUIN Bridge south approaches (an assist in capture of high bridge); LZ B-large triangular parking lot between N-S railline, HOHENFELDER St. and AM WOLLERSHOF St.

c. Objective 3 : Karthaus, old walled town/castle on central ridgeline of KOBLENZ peninsula; LZ C-sports ground and open field adjacent to the south boundary of the castle and west of SIMMENER St; and LZ D-sports grounds 200m northwest of the castle.

Tasks: Task Force A (A Co. 1/AT, 1/Rcl Gun, 1/ADMG) will deplane in LZ A, seize the southern approaches to the New MOSEL high level vehicle bridge, clear any enemy on the bridge and remove all demolitions emplaced thereon. Secondary task: send a squad to capture the fire defense station south of the floodgate on the MOSEL River, and prevent any enemy passage across the footbridge, and link-up with Task Force B to form the western half of the Red bridgehead.

Task Force B (B Co, 2/AT, 2Rcl Gun, 2/ADMG) will deplane in LZ B, capture and clear the RR and BALDUIN bridges, defuze any demolitions and establish the eastern half of the Red bridgehead. Secondary task: assist Task Force A in clearing the ramp complex to the New MOSEL Bridge.

Task Force C 1st Serial (C Co 3/AT, 3/Rcl Run, Mortar Btry) will deplane at LZ C; 2d Serial (Hq & Hq Co (-), Spt Btry (-)) will deplane at LZ D. 1st Serial will capture the walled inner city, set up a strong point firebase, and destroy Blue enemy mortars in KOBLENZ and support the Red bridgehead. From inner city positions above the riverfront areas of KOBLENZ, mortars can deliver accurate high angle direct fire on located enemy positions.

NOTE: 1/278 Mech R. APC platoon (with wrecker and shop trucks attached) will follow the assault units of 3/278 Mech R across the captured bridges and rejoin the battalion as soon as possible.

3. Plan of Operations

a. *Landing Plan*

Battalion commander 1/278 Mech R decided to land each task force at approximately the same time, in order to put the maximum stress on Blue's air defense capabilities, which he estimated would be primarily oriented to defense of the MOSEL River bridges.

TABLE 1

Locations	Distance(m)	Time*(sec)
IP-RP	3500	57.5
RP-LZ A	1800	29.0
RP-LZ B	2000	32.5
RP-LZ C	4000	65.0
RP-LZ D	4200	68.0
Assumed cruise rate, 125 knots = 62m/sec		

TABLE 2

Helo Type	Load Capacity: Troops or Cargo		Troops	Load-Unload Time*(Mins) Cargo			
				Vhcls ea.	Trk & Trlr.	Pallet-ized	Bulk/ Sling
H-5	28	4,500	3	5	--	20	30
H-6	48	10,060	5	5	15	40	40
H-7	120	26,117	30	5	15	90	60
*Times given for daylight; in night blackout, add 5 min to cargo times.							

For the air landing, the sequence will be Task Force C, 1st Serial (so that infantry will be the first element fighting into the inner city, attacking downhill) to LZ C at _____hours; Task Force C,2d Serial (Bn Hq & Hq Co and Support Co elements) to LZ D at _____hours; Task Force B to LZ B at _____hours; and Task Force A to LZ A at ____hours.

b. *Air Movement Plan*

NOTE: by this time the helicopter transport commander (and the armed aerial escort unit commander) have joined in the impromptu planning session, and the number and type of helicopters are known.

The air movement plan consists of an air movement table, an air loading table, and a flight route diagram. For this map exercise, the flight route diagram will be combined with Overlay Red #6, and the air loading and movement combined into a single game format table, entitled COMBINED AIR LOADING AND AIR MOVEMENT Table. The options for the attacker-defender outcome is dependent on the number and type of helicopters available to transport the rifle battalion, which will dictate loadings and mandate the number and density of aerial targets presented to Blue and therefore the probability of successful air landing by a sufficient Red force to accomplish the bridgehead mission. Four options will be presented in section H-3 following.

NOTE: Using H-5 helicopters requires all battalion supply vehicles (8 WV-4 4X2 trucks) to be transported empty; normal train loads will be flown in on succeeding resupply shuttles.

c. Marshalling Plan

The marshalling plan consists of the preparation for combat, move to the loading site(s) and the actual loading of men and material into assigned aircraft. For this exercise, only one marshalling plan will be developed, although variations would occur if helicopter availability necessitated a shuttle air movement, for example. It is assumed that 1/278 Mech R battalion has its combat load on men and supply trucks (not palletized, unless the air landing was a pre-planned contingency of Red), that the battalion, from its reserve position in the second growth woods northwest of KESSELHEIM would arrive at the loading site east southeast of KESSELHEIM in the proper task force organization and on time to meet the loading schedule in assigned aircraft.

d. Operations Overlay
(See Overlay R #7)

4. Support Fire Plan
(See Overlay R #8)

D. ANALYSIS

1. Red Conduct of Air Landing Operation

For the air landing operation, four options will be presented, based on type of helicopters assumed to be available:

a. The first option will consider transport of all elements in/under the H-5 light helicopter (a large number of targets for a restricted number of defender antiaircraft capabilities, but requiring hand loading and unloading of all bulk equipment, a more time consuming operation with helicopter sitting on the ground.

b. The second option will consider transport in H-6 medium helicopters, a lesser number of targets for Blue air defense capabilities, but permitting vehicles to be air-lifted with basic loads stowed aboard, obviating slow bulk cargo manhandling, speeding-up unit debarking and lessening exposure time of parked helicopters.

c. The third option will consider transport of all elements in the H-7 heavy transports; with quick release troop pods and vehicle sling platforms, the helicopters are only momentarily immobile (a hovering touchdown, release and takeoff) targets to a majority of ground weapons. However, the number of helicopters involved is very low, and could permit concentrated antiaircraft fire. Since the capacity of the H-7 is described as (57.5 tons), landing zone selection is more restricted, and task force organization may have to be reorganized accordingly. APCs can be transported in the H-7 transports, adding another consideration.

d. The fourth option, probably the more normal circumstance, is a mix of transport helicopters, with insufficient lift to move the entire battalion simultaneously. A shuttle puts a premium on extreme rapidity of execution by the initial assault wave/serials, and quick turn around of helicopter transports. If the assault wave fails to accomplish its tasks before the second wave/shuttle returns, the defender is sure of the probable LZs, and can be waiting in a baited ambush.

For the air landing operation, 2 armed aerial escort helicopters will be provided for each serial. They will remain in the LZ area to provide suppressive fire support as required (on the shuttle airlift, one gunship may remain in the LZ area, and the second escort the helicopters back for the shuttle). The escort aircraft are H-4 utility helicopters armed with 2 MGs and 2 rocket pods with 18 rockets in each pod.

2. Outcome Options, Air Landing Operation

a. Option 1 All elements transported in 38 H-5 light transports, escorted by 8 H-4 gunships.

(1) *Objectives, LZs and flight route diagram -- (See Overlay Red #6).*
(2) Air loading and air movement table -- (See Table H-5, 1/278 Mech R Bn Air Movement Plan A.
(3) Touchdown in LZ C starting at approximately 0412 hours; LZ D at 0412 +5 seconds; LZ B at 0412; and LZ A at 0411 + 52 seconds.
(4) Possible Results of Option 1;

Blue Redeye teams only in AD role (10 gunners). Serial 1 (C/273 + Mort Btry/278) will fly over Redeye teams at both the PFAFFENDORFOR and HORCHHEIMER-SUD Bridges. It is unlikely that more than 2 missiles could be launched at each Redeye site during the 20-22 seconds crossover time of Serial 1 and 2 at the PFAFFENBERGER Bridge, and 2 more at Serial 1 at the HORCHHEIMER-SUD Bridges. If all 4 missiles destroyed a Red helicopter, the mission might still succeed. Suppressive fire by 4 escort helicopters at PFAFFENBERGER Bridge, and 2 gunships at HORCHHEIMER-SUD Bridges would cut down the accuracy and possibly the tenacity of engagement of firers. While night (and possibly river fog) would not affect the IR homing guidance characteristic, it could affect the early detection, recognition and lead measurement/insertion of the gunner.

Serial 3, following immediately behind Serial 1, might be taken under fire by PFAFFENDORFOR Bridge Redeye team, and both Serials 3 and 4 will probably come under fire of one or all three Redeye teams guarding the MOSEL River bridges, at the critical time of hovering and landing. Additional fire will be received from Blue 1/73 Inf bridge guards and patrols, whose rifles, LMGs and grenades are all effective against sitting helicopters. However, the noise of battle on the north bank of the MOSEL may mask the characteristic beating dissonance of the aircraft, allowing only a short time to target them. Several aircraft could be lost on the ground, but still there appears a good possibility of a successful air landing.

Blue Redeye augmentation teams -- 18 from Combat Support Co. Hq and Scout Pl and/or 28 from Bn Hq & Hq Co. mess teams, will of course, increase the efficiency of the AD by 3 to 5 times (granted that secondary gunners fire as effectively as primary gunners).

It is difficult to evaluate the improvised 50 cal employment. Using tracer ammunition, the layers of shooters could be surprisingly effective, if an air raid warning is sounded and gunner or fire "talker" has a good wide-field night vision device to aim/talk the tracer fire into the numerous targets.

b. Option 2 All elements transported in 19 H-6 medium transport helicopters, escorted by eight gunships.

(1) Objectives, LZs and flight route diagram: (See Overlay Red #3).
(2) Air loading and air movement table: (See Table H-6, 1/278 Mech R Bn Air Movement Plan B.
(3) Touchdown in LZA starting at approximately 0321 hours and landing completed by approximately 0322 hours.
(4) Possible Results of Option 2:

The Red battalion air landing serials follow the same routes in Option 2 as in Option 1. However, because loaded vehicles are driven into the helicopters, rather than empty vehicles hung as sling loads, and since no bulk cargo has to be hand carried and stowed, the operation is launched 50 minutes earlier.

From the Blue defender viewpoint, the incoming transports are cut from 38 to 19 aircraft (although there are still 8 escort gunships), presumably increasing the probability of hitting an airborne transport approximately 1.7 times (this is based on accurate gunnery against aimed-at targets, neglecting incidental -- not aimed-at -- target damage, which obviously is more likely with a greater number/density of targets). Lesser targets improve the rather skimpy Redeye point air defense posture, while a greater density of targers increases the rather low hit probability of a single MG fire cone (tiers of fire may be far more lethal).

Perhaps the major change in outcome possibilities occurs in the time of unloading in the landing zones with ramp doors and cargo stowed inside vehicles or on the soldiers' backs, the helicopter transports making only a very brief stop in the LZs. It is probable that with good SOPs and experienced small unit task forces, they will exit helicopters in less than one minute, despite the accepted time listed in Table H-3.

c. Option 4 Mixed Helicopter Types, Shuttle.

(1) For this option, it is assumed Red division makes available 2 H-5 light transports, 2 H-6 medium and 2 H-7 heavy transports, plus 8 escort gunships. The marshalling and loading area, flight routes, landing zones and objectives remain the same. The organization of serials is changed, plus the addition of the shuttle lift of APCs and a wildcard dual landing on the highway bridges.
(2) The battalion commander, 1/278 Mech Rifle Bn, felt the key to the operation was the successful spot landings on the New MOSEL and BALDUIN Bridges of two sub-task forces -- half of the attached engineer platoon from regiment, plus a rifle and HMG squad from the first platoon of A and B companies. They would be landed at mid-span, with the rifle elements holding off any enemy attempts to cross the bridges from the north, while the engineers cut all electric cables to bridge demolitions.
(3) To cover the south end of the bridges, where it was most likely that the bridge demolition controls were located, he wanted the same assault task forces as in Option 2, i.e., the rifle platoon plus HMG squad and attached AT gun, Rcl Launcher and ADMG subunits from the Bn Support Battery; since 2 H-7 transports were available, he could also take in two APC-3s on the initial lift.

(4) Air loading and air movement table -- (See Table II-7, 1/278 Mech R. Bn Air Movement Plan C.

(5) Touchdown on bridges and in LZB starting at approximately hours and shuttle completed to all LZs by hours.

(6) Possible Results of Option 4:

The mixed types of helicopters are credited with different and ascending speeds as size increases (in the Aggressor manual on characteristics). For the MOBA Map Exercise, a cruising speed in consonance with current known state of the art norms is used. Mixed type in a serial fly at the speed of the slowest. For the H-7 helicopter, it is postulated that they can land in LZB (400 x 150m) but not in the smaller LZA; once the assault units are landed in LZB, H-7 lifts are shifted to LZC (400 x 200m), where less hazardous conditions presumably exist.

The initial lift of the six helicopters (2 H-5, 2 H-6 and 2 H-7) present only limited targets for the 5 Redeye teams guarding the bridges. If both the team chief and gunnerdriver are alerted in the teams, there will be a capability of launching 6 initial-aim missiles at the two H-5 wildcard engineer-infantry assault teams attempting to land on the two bridges and the two giant H-7 helicopters dropping the two flatbed platforms in LZB. If additional personnel of combat support company (18) and Bn Hq and Sv Co (28) have been trained, perhaps 1/3, or 30 additional missile gunners would be within range, and could add to the air defense.

The 50 cal MGs on ground mounts in tiers could be extremely effective if emplaced to cover potential LZs that the enemy did, in fact, fly into. (It is noted in FM101-10-1 (25 Sept 1969), Tabel 5-33, page 5-48, that there is a MG, cal 50, hv, flex, veh-mtd (line item number L91838) and a Mount, MG, antiaircraft, cal 50 (line item number M74755)), so that possibly vehicle mounts and ground mounts for manual tracking of aircraft are still in the inventory and can be made available for urban defense forces.

A key requirement for the defender is to pick up the helicopters flying at nap of the earth altitudes during night/low visibility conditions. This would seem to indicate an IR sight/NOD to get early warning and enable missiles to lock on the target.

3. CONTROL Analysis

An assault helicopter operation crossing over/into enemy lines appears to be dependent on absolute surprise and/or so many apparent targets that the air defense system is over-saturated, to achieve the mission. It seems possible to team up fixed wing close support aircraft making bombing and strafing attacks with numerous heat-emitting chaff (possibly tiny balloons/ducted fan kites with small slow-burning chemical 1-time heaters). Helicopters in individual or very limited numbers appear critically vulnerable in the landing stage -- and in cities, the limited number of possible landing zones would be as apparent to defenders as attackers, hence air and/or ground defenses would probably be sited to cover most sites.

It appears that Option 2 has the best chance of succeeding, however, Control elects to rule the tactical air landing a failure.

SUPPLEMENT 1

BLUE FIRE SUPPORT PLAN

Copy 1
3d BOE (TF), 20th Inf Div
KOBLENZ ( ), GERMANY
071500 Jan 19

Annex (Fire Support) to OPORD 11

Reference: MAP Koblenz 1:25.000 sheets ____, ____, ____, ____.

1. Situation

a. Enemy Forces

(1) Annex A (Intelligence) to OPORD 11
(2) Enemy not expected to utilize nuclear weapons in the urban environment

b. Friendly Forces

(1) BOE Prep to conduct a defense in successive positions at 081800 Jan 75 with BNS on line. Be prepared to move to alternate positions on order.
(2) Three TAF supports 3d BDE TF with 30 sorties daily for TDE period 081800 to 101800.
(3) Artillery Support
(a) 1-47(Gp) FA; 1-73 Inf.
(b) 1-48 FA (-)

2. Mission

1-47 (Group) FA and attached fire elements spt 3d Bde operation with conventional ammunitions to include artillery, air support, and air defense fire.

3. Execution

a. Concept of operations: 3d BDE deploys along S side of railroad line (overlay) with three bns on line. Bns withdraw to successive position. Main defense line in South bank of the Mosel River.

b. Air Support

(1) General. Aircraft will be required for armed reconaissance of air routes, combat air patrol and normal close air support functions.
(2) Allocation: 3d BDE allocated 20 sorties per day. Priority to 1-73 INF.
(3) Miscellaneous. Appendix 1 (Air Fire Support)

c. Artillery Support

(1) FA
(a) General. Artillery will spt the defense with conventional munitions.
(b) Organization for combat. 1-47 (Gp) FA: DS 3d BDE.
(c) Appendix 2 (Artillery Fire Support)
(2) ADA
(a) General. Air defense artillery will provide air defense support to brigade CP and artillery units at 111400 Jan 75.
(b) Appendix 3 (Air Defense Artillery Forece Support)
(3) Miscellaneous
(a) Weather dissemination per 20th Div SOP
(b) Search light: 2 lights attached 1-47 FA EFF 111400 Jan 75.

4. Service Support

a. Div Admin OAD 17

b. ASR (081800-101800 Jan 7)

105 mm How	125
155 mm HOW	110
8 in HOW	60

c. ASP Location

5. Command and Signal

a. SOI, Index 3-74 Eff 081800 Jan

b. FSE located at Bde CP

Walker
BG

Official:

/S/ Fetr
Fetr
S3

Appendices: 1 - Air Fire Spt (omitted)
2 - Artillery Fire Support
3 - Air Defense Artillery Fire Support (omitted)

Copy 1
3d BDE TF, 20th Inf Div
KOBLENZ, GERMANY
07150 Jan 19

Appendix 2 (Artillery Fire Support) to Annex C (Fire Support) to OpOrd 11

1. Counter-preparation fires with commence at H+2 minutes.

2. Organization for Combat:

1 - 47 FA: DS 3DBE TF
1 - 48 FA: Attchd 1-47 FA

3. ASR (081800-10800 Jan)

105 mm HOW	125
155 mm HOW	110
8 in HOW	60

4. Priority of fires to 1-72 inf. initially; 0/0 priority to 1-73 inf.

5. Counter battery status is silent.

6. NFL is indicated in Tab B. All changes must be disseminated immediately.

7. All observation posts will be attacked by smoke and HE.

8. Maximum ordinate of artillery fires in 3d BDE area is 5200 meters.

9. ASP location is:

10. All fires called on friendly positions will be authenticated.

Acknowledge

Walker
BG

Official:

/S/ Feir
Fair
S3

Tabs: A. Target List No. 1
B. Target Overlay No. 1
C. Artillery Fire Support Tables 1-5

Tab A (Target List No 1) to Appendix 2 (Artillery Fire Supp) to Annex C (Fire Support) to OPORD 11

Ln No	Target number	Description	Location	Altitude	Size		Attitude	Source	Remarks
1	CO 1000	RR LINE	967853	90	10	300	5400 mph	MAP	JOHN HENRY SERIES 9
2	CO 1001	RR LINE	963854	90	"	"	5400 mph	"	" " 8
3	CO 1002	RR LINE	960857	90	"	"	5400 mph	"	" " 7
4	CO 1003	RR LINE	955859	90	"	"	4900 mph	"	" " 6
5	CO 1004	RR LINE	949860	90	"	"	4900 mph	"	" " 5
6	CO 1005	RR LINE	943862	90	"	"	4900 mph	"	" " 4
7	CO 1006	RR LINE	937864	90	"	"	4900 mph	"	" " 3
8	CO 1007	RR LINE	930866	95	"	"	4900 mph	"	" " 2
9	CO 1008	RR LINE	924867	95	"	"	4900 mph	"	" " 1
10	CO 1009	BLDG COMPLEX	961851	80	150	150		"	ROADRUNNER SERIES 7
11	CO 1010	AUTOBAHN	955856	75				"	" " 6
12	CO 1011	"	948857	75				"	" " 5
13	CO 1012	"	942859	75				"	" " 4
14	CO 1013	ASSEMBLY AREA	942856	75	150	200	6400 mph	AIRPHOTO	" " 3
15	CO 1014	AUTOBAHN	938861	75				"	" " 2
16	CO 1015	"	931862	75				"	" " 1
17	CO 1016	E-W HIGHWAY	953848	70				"	LEMANS SERIES 3
18	CO 1017	"	944847	70				"	" " 2
19	CO 1018	RJ	937847	70				"	" " 1
20	CO 1019	ASSEMBLY AREA	934846	70	250	250		AIRPHOTO	" COUNTERBORE
21	CO 1020	ASSEMBLY AREA	967878	60	150	250	5000 mph	AIRPHOTO	COUNTERSHIP ON CALL
22	CO 1021	RR LINE	954879	70	10	300	5700 mph	MAP	ON CALL
23	CO 1022	LARGE WAREHOUSE	935869	70	70	500	0200 mph	AIRPHOTO	HE + WP BIN

Tab A (Target List No 1) to Appendix 2 (Artillery Fire Supp. to Annex C (Fire Support) to OPORD II

Ln No	Target number	Description	Location	Altitude	Size		Attitude	Source	Remarks
25	CO 3001	MAJOR RT	944849	75				AIRPHOTO	ON CALL
26	CO 3002	FORTIFIED POSITIONS	925 837	110	50	150	0900 mils	1-72d PATROL	COUNTERPREP
27	CO 3003	ATTACK POSITION	935835	80	75	150	1100 mils	1-72 PATROL	"
28	CO 3004	EARTHWORKS	949839	160	10	100	4800 mils	AIRPHOTO VERIFIED 1-73d PATROL	COUNTERPREP
29	CO 4000	WAREHOUSE	984853	70	20	300	0900 mils	1-73d PATROL	"
30	CO 4001	RR JUNC.	975849	75				MAP	"
31	CO 4002	OBSERVATION POST	978871	100				1-4 CAV	COUNTERPREP FZ VT
32	CO 4003	RR/~~ROAD~~ TRAIL JUNC/BRIDGE	963866	100				AIRPHOTO	ON CALL
33	CO 4004	RJ	958868	70				MAP	ON CALL
34	CO 4005	ENEMY DEF POS.	003847	65	50	400	0900 mils	LNO 1-73	ON CALL
35	CO 4006	"	999 843	65	50	400	1100 mils	LNO 1-73	"
36	CO 4007	"	992841	70	50	400	1300 mils	LNO 1-73	"
37	CO 4008	"	985839	70	50	400	6400 mils	LNO 1-73	"
38	CO 4009	"	986833	70	50	400	6400 mils	LNO 1-73	"
39	CO 4010	"	984829	75	50	400	0900 mils	LNO 1-73	"
40	CO 4011	"	979826	80	50	400	0900 mils	LNO 1-73	"
41	CO 4012	RJ NR ALT POS.	992 835	80				LNO 1-73	"
42	CO 4013	OPEN FIELD	002 837	70	400	400		LNO 1-73	"
43	CO 4014	RJ	008839	70				LNO 1-73	"
44	CO 4015	ROSS MORTAR POS.	000 831	70				LNO 1-73	"
45	CO 7000	~~FIELD COVERING FIRE~~ AVENUE OF APPROACH	999853	60				LNO 1-73	DT FIN DIR
46	CO 7001	FINAL PROTECTIVE FIRES	995 844 – 001 848	70	800	10	0900 mils	LNO 1-73	1-47 FA, ON CALL
47	CP 7000	MINEFIELD/COVERING FIRE	971836	75				ADE LNO 20 ENGR	CIP HE, QUICK + VT
48	CP 7001	"	974838	75				ADE LNO 20 ENGR	CIP "

Tab A (Target List No 1) to Appendix 2 (Artillery Fire Supp to Annex C (Fire Support) to OPORD 11

Ln No	Target number	Description	Location	Altitude	Size		Attitude	Source	Remarks
49	CP 7002	MINEFIELD COVERING FIRE	977840	75				BDE LNO 20 EASR	CIP HE, SMK + VT
50	CP 7003	"	981843	75				BDE LNO 20 EASR	CIP "
51	CP 7004	FINAL PROTECTIVE FIRE	979830 - 982837	85	800		0500 ↑	LNO 1-73	1-48 FA DT FIRE IN, ON CALL
52	CP 7500	AMMON CONCEALED POS - BLOG	994850	70	200	400	0900 ↑	LNO 1-73	BIN HE + WP
53	CP 7501	"	994847	70	100	300	0500 ↑	LNO 1-73	"
54	CP 7502	"	977846	75	75	150	5400 ↑	LNO 1-73	"

Tab C (Artillery Fire Support Table Nr 1) to Appendix 2 (Artillery Fire Support) to Annex C (Fire Support) to OPORD

COUNTERPREP FIRES

Ln No	Organization	Firing Unit	H+2	H+7	H+12	H+17	H+22	H+27	On Call Targets	Remarks
1	A, 1-47	A	CO 3000	CO 3001	LEMANS FZ QK + VT		CO 3002			
	B, 1-47	B	CO 3000	CO 3001	LEMANS FZ QK, VT		CO 3003			
	C, 1-47	C	CO 1022 FZ VT	CO 1021	CO 4004	CO 4003	CO 3004			
	A, 1-48	A	CO 4002		ROADRUNNER FZ QK, VT		CO 1010			
	B, 1-48	B	CO 4002		ROADRUNNER FZ QK, VT		CO 1002			
	D, 1-48	D	CO 1022 FZ QK T DELAY		JOHN HENRY FZ QK, DELAY		[illegible]	CO 1003		

Tab C (Artillery Fire Support Table Nr 2) to Appendix 2 (Artillery Fire Support) to Annex C (Fire Support) to OPOR

SERIES ROADRUNNER

Ln No	Organization	Firing Unit	2	4	6	8	10	12	On Call Targets	Remarks
1	1-48	A	CO1014 / 12	CO1013 / 12	CO1011 / 12		CO1009 / 6			
2	1-48	B	CO1015 / 12	CO1012 / 12	CO1010 / 12		CO1009 / 6			

Tab C (Artillery Fire Support Table Nr 3) to Appendix 2 (Artillery Fire Support) to Annex C (Fire Support) to OPOF

SERIES JOHN HENRY

Ln No	Organization	Firing Unit	2	4	6	8	10	12	14	On Call Targets	Remarks
1	1-48	D	CO1008 4	CO1007 4	CO1006 4	CO1005 4	CO1004 4	CO1003 4	CO1002 4	CO1001 4	CO1000 4		F2 QK

Tab C (Artillery Fire Support Table Nr 4) to Appendix 2 (Artillery Fire Support) to Annex C (Fire Support) to OPORD _____

SERIES LE MANS

Ln No	Organization	Firing Unit	2	4	6	8	10	12	On Call Targets	Remarks
1	1-47	A	CO 1018 / 18	CO 1017 / 18	CO 1019 / 18	CO 1018 / 12				
2	1-47	B	CO 1017 / 18	CO 1016 / 18	CO 1019 / 18	CO 1018 / 12				

Tab C (Artillery Fire Support Table Nr 5) to Appendix 2 (Artillery Fire Support) to Annex C (Fire Support) to OPORD

Groups of Targets

Ln No	Organization	Firing Unit	CIP							On Call Targets	Remarks
1	1-47	A	CP 7000 / 18								QK + VT
2	1-47	B	CP 7000 / 18								"
3	1-47	C	CP 7003 / 18								"
4	1-48	A	CP 7001 / 12								"
5	1-48	B	CP 7002 / 12								"

SUPPLEMENT 2

BLUE TASK FORCE ORGANIZATION

TROOP LIST - Blue Forces

		TGT Desig	TOE
20th Inf Div	20th Inf Div	C	7H
3d Brigade Task Force, 20th Inf Div	3d BDE CTF, 20th Inf Div	CC 0001-0999	7-42H Co 1000-1999
1st Bn, 71st Inf	1-71 Inf	CC 0001-0199	7-15H Co 2000-2999
Hq and Hq Co	HHC/1-71 Inf	CC0001-0049	7-16H
Combat Support Co.	CBT SPT/1-71 Inf	CC0050-0099	7-28H
Co A	Co A/1-71 Inf	CC0100-0124	7-18H
Co B	Co B/1-71 Inf	CC0125-0149	7-18H
Co C	Co C/1-71 Inf	CC0150-0174	7-18H
1st bn, 72d Infantry	1-72 Inf	CC0200-0399	7-15H Co 3000-3999
Hq and Hq Co	HHC/1-72 Inf	CC0200-0249	7-16H
Combat Support Co	CBT Spt/1-72 Inf	CC0250-0299	7-28H
Co A	Co A/1-72 Inf	CC0300-0324	7-18H
Co B	Co B/1-72 Inf	CC0325-0349	7-18H
Co C	Co C/1-72 Inf	CC0350-0374	7-18H
1st bn, 73d Infantry	1-73 Inf	CC0400-0599	7-15H Co 4000-4999
Hq and Hq Co	HHC/1-73 Inf	CC0400-0449	7-16H
Combat Support Co	CBT Spt/1-73 Inf	CC0450-0499	7-28H
Co A	Co A/1-73 Inf	CC0500-0524	7-18H
Co B	Co B/1-73 Inf	CC0525-0549	7-18H
Co C	Co C/1-73 Inf	CC0500-0574	7-18H
1st bn, Mechanized, 76th Infantry minus	1-76 Mech (-)	CC0600-0799	7-45H Co 5000-5999
Hq and Hq Co.	HHC/1-76 Mech	CC0600-0649	7-46H
Combat Support Co	CBT Spt/1-76 Mech	CC0650-0699	7-48H
Co A	Co A/1-76 Mech	CC0700-0724	7-47H
Co B	Co B/1-76 Mech	CC0725-0749	7-47H
Co A, 1st Bn, 1st Armor	Co A/1-1 Armor	CC0750-0774	
Troop A, 1st Sq, 21st Armored Cavalry	A/1-21 CAV		17-107H FP only CO5000-6199
Co A, 20th Eng Bn	A/20th ENGR		5-147H Not Asgnd
Battery B (155, Towed)	B/1-48 FA	CP 7700-7799	6-167H
Battery C (155, Towed)	C/1-48 FA	CP7800-7899	6-167H
Battery D (8 in Sp)	D/1-48 FA	CP7900-7999	6-356H
1st Bn, (Honest John), 49th Field Artillery	1-49 FA	CQ7000-7999	6-175H
Hq, Hq and Service Battery	HHIS/1-49 FA	CQ7000-7779	6-176H
Battery A	A/1-49 FA	CQ7800-7899	6-177H
Battery B	B/1-49 FA	CQ7900-7999	6-177H
1st Bn, (Chapparal/Vulcan), 439th Air Def Artillery	1-439 ADA CC/V	CR7000-7999	44-325H
Hq and Hq Battery	HHB/1-439 ADA	CR7000-7599	44-326H
Battery A (Vulcan)	A/1-439 ADA	CR7600-7699	44-327H
Battery B (Vulcan)	B/1-439 ADA	CR7700-7779	44-327H
Battery C (Chapparal)	C/1-439 ADA	CR7800-7899	44-328H
Battery D (Chapparal)	D/1-439 ADA	CR7900-7999	44-328H

		TOE	LNO TGT DESIG
20th Aviation bn (Combat)	20th AVN	7-75H	
Hq and Hq Co	HHC/20th AVN	7-76H	
Co A (Assualt), 20 Aviation bn	A/20th AVN	7-77H	
Co B (General Support), 20 Aviation bn	B/20th AVN	7-78H	
20th Engr bn (-)	20th ENGR (-)	5-145H	
Hq and Hq Co	HHC/20th ENGR	5-146H	
Co B	B/20th ENGR	5-147H	
Co C	C/20th ENGR	5-147H	
Co D	D/20th ENGR	5-147H	
Co E (Bridge)	E/20th ENGR	5-148H	
1st platoon (Heavy Raft)	1/E/20th ENGR		
2d platoon (Heavy Raft)	2/E/20th ENGR		
3d platoon (Armored Vehicle Launch Bridge)	3/E/20th ENGR		
1st Brigade, 20th Inf Div	1sBDE/20th Inf Div	CA0001-0999	7-42H	CM 1000-1999
1st bn, 66th Inf	1-66 Inf	CA0001-0199	7-15H	CM 2000-2999
1st bn, 67th Inf	1-67 Inf	CA0200-0399	7-15H	CM 3000-3999
2st bn, 68th Inf	1-68 Inf	CA0400-0599	7-15H	CM 4000-4999
2d Brigade, 20th Inf Div	2d BDE/20th Inf Div	CB0001-0999	7-42H	CN 1000-1999
1st bn, 69th Inf	1-69 Inf	CB0001-0199	7-15H	CN 2000-2999
1st bn, 70th Inf	1-70 Inf	CB0200-0399	7-15H	CN 3000-3999
1st bn, 1st Armor (-)(+)	1-1 Armor	CK0001-0999	17-35H	FO Will Use
Hq and Hq Co	HHC/1-1 ARMOR	CK0001-0099	17-36H	Designators From
Service Company	SVC/1-1 ARMOR		17-39H	INO of Unit of
Co B	Co B/1-1 ARMOR	CK0100-0199	17-37H	Attachment
Co C	Co C/1-1 ARMOR	CK0200-0299	17-37H	
Co C, 1st bn, Mech, 76th Inf	Co C/1-76 MECH	CK0300-0399	7-47H	
1st Squadron, 21st Armored Cavalry (-)	1-21 CAV	CL0001-0999	17-105H	FO Will Use
Hq and Hq Troop	HHT/1-21 CAV	CL0001-0099	17-105H	Designators From
Troop B	B/1-21 CAV	CL0100-0199	17-107H	INO of Unit of
Troop C	C/1-21 CAV	CL0200-0299	17-107H	Attachment
Troop D (Airmobile)	D/1-21 CAV	CL0300-0399	17-108H	
20th Inf Div Artillery	20th Inf Div FA	CY1000-9999	6-300H	FSE CZ 1000-9999
Hq and Hq Battery	HHB/20th Inf Div FA	Uses Divarty #s	6-300H	
1st bn (105, Towed) 45th Field Artillery	1-45 FA	CM7000-7999	6-155H	CM 1000-4999
1st bn (105, Towed) 46th Field Artillery	1-46 FA	CN7000-7999	6-155H	CN 1000-3999
1st bn (105, Towed) 47th Field Artillery (+)	1-47 FA (+)	CO7000-7999	6-155H	CO 1000-6199
Hq and Hq Battery	HHB/1-47 FA	CO7000-7599	6-156H	
Service Battery	SVC/1-47 FA		6-159H	
Battery A	A/1-47 FA	CO7600-7699	6-157H	
Battery B	B/1-47 FA	CO7700-7799	6-157H	
Battery C	C/1-47 FA	CO7800-7899	6-157H	
Battery A, 1st bn (155/Towed), 48th Field Art	A/1-48 FA	CO7800-7999	6-167H	
1st bn (155/8 INSP), 48th Field Art (-)	1-48 FA (-)	CP7000-7999	6-165H	
Hq and Hq Battery	HHB/1-48 FA	CP7000-7699	6-166H	
Service Battery	SVC/1-48 FA		6-169H	

SUPPLEMENT 3

RED TASK FORCE ORGANIZATION

38th Mechanized Division	38th MECH DIV 10
280th Mechanized Inf Regiment	280th MECH REGT 12
281st Mechanized Inf Regiment	281st MECH REGT 12
278th Mechanized Inf Regiment	278th MECH REGT 12
1st bn, 278th Mechanized	1-278 MECH 14
1st Co, 1st bn	1/1-278 MECH 14
2d Co, 1st bn	2/1-278 MECH 14
3d Co, 1st bn	3/1-278 MECH 14
Mortar Battery, 1st bn	MORT/1-278 MECH 14
Support Battery, 1st bn	SPT/1-278 MECH 14
2d bn, 278th Mechanized	2-278 MECH 14
1st Co, 2d bn	1/2-278 MECH 14
2d Co, 2d bn	2/2-278 MECH 14
3d Co, 2d bn	3/2-278 MECH 14
Mortar Battery, 2d bn	MORT/2-278 MECH 14
Support Battery, 2d bn	SPT/2-278 MECH 14
3d bn, 278th Mechanized	3-278 MECH 14
1st Co, 3d bn	1/3-278 MECH 14
2d Co, 3d bn	2/3-278 MECH 14
3d Co, 3d bn	3/3-278 MECH 14
Mortar Battery, 3d bn	MORT/3-278 MECH 14
Support Battery, 3d bn	SPT/3-278 MECH 14
278th Medium Tank Battalion	278 MDM TK 24
Hq and Svc Co	H+S MDM TK 24
1st Tank Co	1/278 MDM TK 24
2d Tank Co	2/278 MDM TK 24
3d Tank Co	3/278 MDM TK 24
278th Regimental Artillery	278 ARTY 16
Hq and Svc Battery	H+S/278 ARTY 16
Anti-tank Gun Battery	AT/278 ARTY 16
Anti-tank Guided Missile Battery	ATGM/278 ARTY 16
Mortar Battery	MORT/278 ARTY 16
Air Defense Gun Battery	AD/278 ARTY 16
Air Defense Machine Gun Battery	ADMG/278 ARTY 16
278th Reconnaissance Platoon	RECON/278 MECH 12
38th Division Artillery	38th DIVARTY 18
Hq Battery	Hq/38 DIVARTY 18
38th Artillery Regiment	38 ARTY REGT 18
Hq and Svc Battery	HHB/38 ARTY 18
Gun/Howitzer Bn (152mm)	G-HOW/38 ARTY 18
Hq Battery	HHB/G-HOW/38 ARTY 18
1st Gun/Howitzer Battery (152mm)	1/G-HOW/38 ARTY 18
2d Gun/Howitzer Battery (152mm)	2/G-HOW/38 ARTY 18
3d Gun/Howitzer Battery (152mm)	3/G-HOW/38 ARTY 18
Svc Battery	SVC/G-HOW/38 ARTY 18
Mortar bn (160mm)	MORT/38 ARTY 18
Hq Battery	HQ/MORT/38 ARTY 18
1st Mortar Battery (160mm)	1/MORT/38 ARTY 18
2d Mortar Battery (160mm)	2/MORT/38 ARTY 18
3d Mortar Battery (160mm)	3/MORT/38 ARTY 18
Svc Battery	SVC/MORT/38 ARTY 18
Howitzer bn	HOW/38 ARTY 18
Hq Battery (122mm)	HQ/HOW/38 ARTY 18
1st Howitzer Battery (122mm)	1/HOW/38 ARTY 18
2d Howitzer Battery (122mm)	2/HOW/38 ARTY 18
3d Howitzer Battery (122mm)	3/HOW/38 ARTY 18
Svc Battery	SVC/HOW/38 ARTY 18
38th Anti-Tank bn	38 AT 18
Hq Battery	HQ/38 AT 18
1st Anti-tank Battery	1/38 AT 18
2d Anti-tank Battery	2/38 AT 18
3d Anti-tank Battery (Guided Missile)	3/38 AT 18
Svc Battery	SVC/38 18
38th Rock Launcher bn	38th RL 18
Hq and Svc Battery	HHS/38 RL 18
1st Rocket Battery (200mm)	1/38 RL 18
2d Rocket Battery (NEROND)	2/38 RL 18

38th Medium Rocket Launcher bn (140mm)	38 MRL	18
Hq Battery	HQ/38 MRL	18
1st Medium Rocket Battery (140mm)	1/38 MRL	18
2d Medium Rocket Battery (140mm)	2/38 MRL	18
3d Medium Rocket Battery (140mm)	3/38 MRL	18
Svc Battery	SVC/38 MRL	18
38th Air Defense bn	38 AD	18
Hq and Svc Battery	H+S/38 AD	18
1st Air Defense Gun Battery	1/38 AD	18
2d Air Defense Gun Battery	2/38 AD	18
3d Air Defense Gun Battery	3/38 AD	18
4th Air Defense Gun Battery	4/38 AD	18
5th Air Defense Gun Battery	5/38 AD	18
38th Target Acquisition Battery	38 TGT ACQ	18
38th Reconnaissance Co	RECON/38 MECH DIV	20
Hq Section	HQ/RECON/38 MECH DIV	20
1st Reconnaissance Platoon	1/RECON/38 MECH DIV	20
2d Reconnaissance Platoon	2/RECON/38 MECH DIV	20
3d Reconnaissance Platoon	3/RECON/38 MECH DIV	20
4th Reconnaissance Platoon	4/RECON/38 MECH DIV	20
38th Engineer bn	38th ENGR	20
Hq and Svc Co	H+S/38 ENGR	20
Amphibious Co	AMP/38 ENGR	20
Pontoon Co	PON/38 ENGR	20
Construction Co	CONST/38 ENGR	20
Mine Co	MINE/38 ENGR	20

SUPPLEMENT 4

RED AIRMOBILE OPERATION PLANNING DATA

For the Red tactical air landing operation, it is assumed that 15 of the 17 trucks in a mechanized rifle battalion are 2 1/2 ton 4x2 supply vehicles weighing 9900 pounds (about 500 pounds less than a U.S. 6x6 2 1/2 ton truck) or 4500 kg. Equipped soldiers are assumed to average 240 pounds, or 110 kg each. Aggressor cargo helicopters are armed with machine guns and can mount additional weapons — MGs, small cannon and "homing torpedoes." The H-5 light and H-6 medium transport helicopters are described as having rear doors for rapid loading and the doors are assumed to be large enough and include ramps, so that vehicles can enter and exit. The H-6 heavy transport helicopter is not described as having a door or ramp, and is assumed to have detachable cabin-like pods for personnel transport and slings or a flatbed platform for heavy cargo (up to 31 tons).

These assumptions permit wide alternatives to be examined in the numbers and composition of Red mechanized rifle battalion aerial serials for the helicopter air landing operation. A stripped unit (i.e., without APC and the two heavy trucks, wrecker and shop van) could be transported in all three of the cargo helicopters or combinations of them. The APCs could be transported, but only by the H-7 heavy transport.

In order to set up simulated air loading tables for different optional mexes of helicopters and objectives for the Red tactical air landing, a nominal set of weights (size/cubage is assumed to be consonant with the cargo space and doors of Aggressor helicopters) for Aggressor weapons, materiel, ammunition, water and rations has been approximated as follows (Table H-1):

TABLE H-1

Type	Weight (in kg) Item	Ammo	Rations	Water
Soldier w/ equip.	110			
Truck, WV-4	4,500			
AD MG, SP Dual	2,000			
APC	13,200			
57 mm AT Gun (SP)	1,255			
82 mm Rcl Gun	16			
Rifle Platoon		352	165	297
Hv Mg Platoon		497	159	286
Mortar Battery	(600 rds)	3,322	283	514
AT Gun Platoon	(210 rds)	1,323	118	198
Rcl Gun Platoon	(210 rds)	1,890	89	150
AD MG Platoon	(8,000 rds)	1,418	106	171
Bn Hq & SvCo(-)		503	265	477

With these weights and compatible cubage, air loading tables for 1/273 Mech R Bn can be prepared. The Air Movement Plan (air movement table, flight route diagram and air loading table) must support the Landing Plan (sequence, time, IZ place (s) for troops and materiel, which is further based on the ground tactical plan — the objectives, the battalion elements assigned to capture the objectives, urban terrain features of objectives and landing zones, and contingency actions for the obscure intelligence status that may impend for both opponents.)

To calculate times, sequences, loading, etc. the following data was measured/calculated/defined in unit SOP (except for distances measured on the map, this type information would be compiled in the Game Data Handbook). (Tables H-2 and H-3.)

Table H-3

	Locations	Distance (m)	Time*(sec)
IP-RP	IP-RP	3550	57.5
	RP-LZ A	1800	29.0
	RP-LZ B	2000	32.5
	RP-LZ C	4000	65.0
	RP-LZ D	4200	68.0

* Assumed cruise rate, 125 knots = 62m/sec.

Note: Using H-5 helicopters required all battalion supply vehicles (8WV-4 4x2 trucks) to be transported empty; normal train loads will be flown in on succeeding resupply shuttles.

Time of arrival at the landing zones (LZs) will vary in accordance with the type helicopters, because of the loading time (Table H-3). The distance traveled is relatively short, the variance in time the shortest to the longest route being 39 seconds of uninterrupted flight; therefore the sequence of Task Force serials will be the important consideration.

Table H-3

Helo Type	Load Capacity: Troops or Cargo		Load-Unload Time* (min)				
			Troops	Cargo			
				Vehicles ea	Truck & Trailer	Pallet-ized	Bulk/ Sling
H-5	28	4,500	3	5		20	30
H-6	48	10,060	5	5	15	40	40
H-7	120	26,117	30	5	15	90	60

* *Times given for daylight; in night blackout, double times.*

The air movement plan consists of an air movement table, an air loading table and a flight route diagram. For this map exercise, the flight route diagram will be combined with Overlay Red #5, and the air loading and movement combined into a single game format table, entitled COMBINED AIR LOADING AND MOVEMENT Table (Form: Table H-4). The options for the attacker-defender outcomes is dependent on the number and type of helicopters available to transport the rifle battalion, density of aerial targets presented to Blue and therefore the probability of successful air landing by a sufficient Red force to accomplish the bridgehead mission. Four options will be presented in Section H-3 following.

The marshalling plan consists of the preparation for combat, move to loading site(s), and the actual loading of men and material into assigned aircraft. For this exercise, only one marshalling plan will be developed, although variations would occur if helicopter availability necessitated a shuttle air movement, for example. It is assumed that 1/278 Mech R battalion has its combat load on men and supply trucks (not palletized, unless the air landing was a pre-planned contingency of Red), that the battalion, from its reserve position in the second growth woods northwest of Kesslheim would arrive at the loading site east southeast of Kesselheim in the proper task force organizations and on time to meet the loading schedule in assigned aircraft.

Work Sheet Option 1: All H-5 acft

A. Support Btry breakout

1. Hq Sec (2-O, 3-EM)
2. AT Gun Pl (1-O, 17 EM); 3 Sq 5 EM & 1-57 mm AT gun ea.
3. Rcl Gun Pl (1-O, 13 EM); 3 Sq 4 EM & 1-82 mm Rcl gun ea.
4. ADMG Pl (1-O, 15-EM); 2 Sq 7-EM & 1-14.5 mm ADMG ea.

B. Assignment to Task Forces

1. Task Force A
   1/AT Gun Sq + Lt = 6 Trps
   1/Rcl Gun Sq = 4 Trps
   1/ADMG Sq + Pl Sgt = 8 Trps
   1 Btry Hq Trk & Drvr = 1 Trp

2. Task Force B
   2/AT Gun Sq + Pl Sgt = 6 Trps
   2/Rcl Gun Sq = 4 Trps
   2 ADMG Sq + Lt = 8 Trps
   1 Btry Hq Trk & Drvr = 1 Trp

3. Task Force C
   3/AT Gun Sq. + 1 = 6 Trps
   3/Rcl Gun Sq. + Lt & Pl Sgt = 6 Trps
   Btry Hq Sec (-) = 3 Trps

C. Serial #1 Task Force C

1. "C" Co Mech R (dismtd)
   1st Pl (26 trps + 2 Hq) 28 @ 110 = 3080 kg
   2d, 3d Pls, ditto = 6160
   Hv, Mg Pl (26 trps + 1 Hq) 27 @ 110 = 2970

Equipment:	Ammo	Rations	Water	Total
Rifle Pl	352	165	296	813 kg
MG Pl	497	159	286	942
Trk, WV-4				4500

2. 3/AT Sq. 6 Trps @ 110 = 660 kg
   1-57mm AT gun, SP = 1255
   Equipment: 1/3 Pl total, Table H-1: $\frac{1634}{3}$ = 545

3. 3/Rcl Sq + 2, 6 Trps @ 110 = 660 kg
   1-82 mm Rcl gun = 16
   Equipment - 1/3 Pl total, Table H-1 $\frac{2129}{3}$ = 710

4. Support Btry Hq (-) 3 Trps @ 110 = 330 kg

5. Mortar Btry 48 trps @ 110 = 5280 kg
   Equipment (incl 3 mortars), Table H-1 = 4119
   2 Trks WV-4 @ 4500 = 9000

D. Serial #2 Task Force C

1.	Bn Hq & Sv Co (less APC pl & 2 drvrs) 40 trps @ 110 =	4400 kg
	Equipment (indiv.) 503 (ammo) + 237 (nations) 424 (water)	1245
	Signal (radios 2488, wire 1200) (est)	3688
	Operations CP (est)	600
	Service (mess, maintenance etc) (est)	2050
	Attached medical team (1 surgeon, 4 med techs)	550
	Medical equip (Bn. aid sta, incl generator)	4408

E. Serial #3 Task Force B

1.	"B" Co. Mech. R (dismtd.) (Same as C Co)	
2.	2/AT Sq, 6 trps @ 110	660 kg
	1-57mm AT Gun, SP	1255
	Equipment: 1/3 Pl total, Table H-5	545
3.	2/Rcl Sq, 4 trps @ 110	440 kg
	1-82 mm Rcl gun	16
	Equipment: 1/3 Pl Total	710
4.	2/ADMG Sq, 8 trps @ 110	880 kg
	1-14.5mm ADMG, SP	2000
	Equipment: 1/2 Pl total $\frac{1685}{2}$	843
5.	1 Dvr. (Btry Hq. Sec) @ 110	110
	1 Trk, WV-4	4500

F. Serial #4 Task Force A

1.	"A" Co., Mech R. (dismtd) (Same as C Co)	
2.	1/AT Gun Sq + Lt = 6 Trps @ 110 =	660 kg
	1-57mm AT Gun, SP	1255
	Equipment: 1/3 Pl total	545
3.	1/Rcl gun Sq. 4 trps @ 110 =	440 kg
	1-82mm Rcl gun	16
	Equipment: 1/3 Pl total	710
4.	1/AD MG Sq + Pl Sgt 8 Trps @ 110 =	880
	1-14.5 mm ADMG, SP	2000
	Equipment: 1/2 Pl total	843
5.	1 Drvr (Btry Hq Sec) @ 110 =	110
	1 Trk, WV-4	4500

Work Sheet Option 1: H-5 light helos

Serial #1. Task Force C (C/278 + element of Spt Btry + Mortar Btry)

1.	1/C (26 + 2Hq) 28 trps	3080 kg
	Basic load 813	813
		3893 kg
2.	and 3. 2/C and 3/C ditto	
4.	HMG/C (26 + 1 Hq) 27 trps	2970 kg
	Basic load 942	942
		3912 kg
5.	C Co truck (sling load)	4500 kg
	Support Btry elements	
6.	3/AT gun (6) + 3/Rcl (6) + Btry Hq Sec(3), 15 trps	1650 kg
	Basic load (545 + 1255) + (710 + 16) +87	2613
		4263 kg

Mortar Battery

Mortar battery will split into two groups for H-5 helicopter transport. 1st and 2nd Mortar platoons in one helicopter, and 3rd Mortar platoon plus Btry Hq (FDC) in a second helicopter, plus 2 helicopters to sling lift the battery trucks (empty). The basic load of the battery (200 rounds per firing tube) plus the troops exceed the capacity of 2 helo's by approximately 400 kg. Hence, for H-5 helicopters, the ammunition load is reduced to 175 rounds/tube.

7.	2 Mortar pl (26)	2860 kg
	Basic load 432 + 2 7 rds (1207)	1639
		4499 kg
8.	Mortar pl (13) + Btry Hq/FDC (9) 22 trps	2420 kg
	Basic load 365 + 308 rds (1712)	2077
		4497 kg
9. and 10.	1 Btry truck, ea. (sling load, 4500 kg)	

Serial #2. Loading (H-5 light helos)
Bn Hq & Sv Co plus attached Medical Detachment

1.	Hq Sec (16) + Sig Pl(-) (12), 28 trps	3080 kg
	Basic load for 28 trps (813) + CP equip (600)	1413
		4493 kg
2.	Sv Pl (10) + all medics (5), 15 trps	1650 kg
	Basic load 290 + 83 (no ammo for medics) + sv equip (2050)	2423
		4073
3.	Sig Det (2) + signal equipment, 2 trps	220 kg
	Basic load 58 + 3688	3746
		3966 kg
4.	Medical equipment (aid station + generator)	4408 kg
5.-12.	8 Service Platoon trucks, 4500 kg ea	36000 kg

Serial #3 Task Force B (H-5 light helos)

1. B/278 Mech R - same as C/278
5. 4 platoon helos, troops and basic loads
   1 helo, company truck

6. AT gun & Rcl gun sqs 10 trps — 1100 kg
   Basic load (545 + 1255) + (710 + 16) — 2526
   3626 kg

7. ADMG Sq (8) and Btry Hq driver (1) 9 trps — 990 kg
   Basic load (843 + 2000) + 29 — 2872
   3862 kg

8. Support Btry truck — 4500 kg

Serial #4 Loading (H-5) light helos), TFA
1. - 8. A/278 Mech R - same as B/278, 8 helos

COMBINED AIR LOADING & AIR MOVEMENT TABLE

Reference: Map Koblenz Quad

General Data

1. Marshalling area: Industriehafen, Kesselheim
2. Cruise speed: 125 knots
3. Aircraft interval 1 & 2 in parallel columns, 140m interval between acft.
4. Routes: North from loading area to BENDORF Bridge orbit until serials formed
5. Critical points
   IP = SE end of Industrie hafen
   RP = Deutches Eck
   (See flight rt diagram)

Serial No.	Date	Unit	Helicopters Type	No.	Load	Time Load	Take Off	X-IP	Destination
1	-	1/C 278	H-5	1-1	28 Trps + basic load 813 kg	0250	0320	0400	LZ C
		2/C 278		1-2	ditto	0250	0321		
		3/C 278		1-3	ditto	0250	0322		
		MG/C 278		1-4	27 Trps + basic load 942 kg				
		C Co Trk		1-5	Sling load	0250	0323		
		3/AT 3/Rd		1-6	15 Trps + AT Gun + Rcl Gun + basic loads--2526 kg	0245	0324		
		½ Mortar		1-7	26 Trps (1st & 2d Pl) + 1639 kg basic load (217 rds)	0250	0325		
		½ Mortar		1-8	22 Trps (3d Pl & Btry Hq) + 2077 kg basic load (308 rds)	0250	0326		
				1-9	Btry trk	0250	0327		
				1-10	Btry trk	0250	0328	+ 18 sec	
2	-	Bn Hq Sv Co	H-5	2-1	Hq & Sig Sec (28 trps)+1413 kg	0250	0320	0400	LZ D
				2-2	Sv Pl + Medics (15) + 2423 kg	0250	0321		
				2-3	Sig Det (2) + Sig Equip 3746 kg	0240	0322		
				2-4	Medical equip 4408 kg		0323		
				2-5 thru 2-12	8 Sv Pl trucks 4500 kg ea	0250	0323 to 0331	+22 sec	

Table ~~five~~
1/278 Mech Rifle Bn Air Movement Plan A

COMBINED AIR LOADING & AIR MOVEMENT TABLE

Reference: Map same
General Data
1. Marshalling area: same
2. Cruise speed: same
3. Aircraft interval columns, 140 serials 2 & 3 in parallel between acft
4. Routes: same
5. Critical points same

Serial No.	Date	Unit	Helicopters			Time			Destination
			Type	No.	Load	Load	Take Off	X-IP	
3	-	1/B 278	H-5	3-1	28 Trps + basic load 813 kg	0321	0351	0400 +305	LZ B
		2/B 278		3-2	ditto	0322	0352		
		3/B 278		3-3	ditto	0323	0353		
		MG/C 278		3-4	27 Trps + basic load 942 kg	0324	0354		
		B Co Trk		3-5	Sling load	0325	0355		
		2/AT,2/Rcl		3-6	2 SQ, AT Gun, Rcl gun + 1255 kg	0326	0356		
		2/ADMG		3-7	SQ, ADMG, SP + 843 kg	0327	0357		
		Spt Btry Trk		3-8	Sling load	0328	0358	+ 14sec	
4	-	1/A 278	H-5	4-1	28 Trps + basic load 813 kg	0321	0351	0400 +30 sec	LZ A
		2/A 278		4-2	ditto	0322	0352		
		3/A 278		4-3	ditto	0323	0353		
		MG/A 278		4-4	27 Trps + basic load 942 kg	0324	0354		
		ACo Trk		4-5	Sling load	0325	0355		
		1/At,1/Rcl		4-6	2 Sq, ATgun, Rcl gun + 1255 kg	0326	0356		
		1/AD MG		4-7	Sq, ADMG, SP + 843 kg	0327	0357		
		Spt Btry Trk		4-8	Sling load	0328	0358	+ 14 sec	

Table ~~5~~ (Cont.)

Red 1/278 Mech Rifle Bn Air Movement Plan A

Work Sheet Option 2: All in H-6 Medium Helos 10060 kg
48 trps

Serial #1 Task Force C--C/278 + elements of Spt. Btry + Mortar Btry

Plane No.

1-1	1/C (26 + 2 Hq) + HMG Sq (8) + 3 (ATG (6+3Hq), 45 trps	4950 kg
	Basic load 813 + 314 + (545 + 1255 + 87) =	3014
		7964 kg
1-2	2/C (28) + HMG Sq (8 + 3 Hq) + 3/Rcl (6), 45 trps	4950 kg
	Basic load 813 + (314 + 87 + 726 =	1940
		6890 kg
1-3	3/C (28) + HMG Sq (8) + Co truck, 36 trps	3960 kg
	Basic load 813 + 314 + 4500 =	5627
		9587 kg
1-4	1/2 Mortar Btry (24) + 1 Btry truck, 24 trps	2640 kg
	Basic load (300 rds) 1661 + 4500	6161
		8801 kg
1-5	1/2 Mortar Btry (ditto)	8801 kg

Serial #2 Task Force C--Bn Hq & Sv. Co. (less APC Pl) + Att Medics

Plane No.

2-1	Bn Hq Sec (16) + CP Equip + 1 trk, 16 trps	1760 kg
	Basic load 464 + CP equip (600) in truck (4500)	5564
	Bn trains* (resupply)	1936
		9260 kg
	(* Each of 8 Bn trains trucks carries 3000 kg)	
2-2	Medics (5) + aid sta (less generator) + trk, 5 trps	555 kg
	Basic load: 83 + 1678 + 4500	6261
	Bn trains* (resupply)	1239
		8055 kg
2-3	Sig Pl (14) + 1 truck	1540
	Basic load (407) + part of sig equip (2593) + 4500	7500
		9040 kg
2-4	Sv Pl (less 4 drivers) (6) + 1 truck	660 kg
	Basic load 174 + sv equip (2050) + 4500	6724
	Bn trains* (resupply)	776
		8160 kg
2-5	1 driver + 1 truck	110 kg
	Basic load 29 + excess signal (1095) + 4500	5624
	Bn trains* (resupply)	1876
		7610 kg

2-6	1 driver + 1 truck	110 kg
	Basic load 29 + operator (2730) + 4500	7259
	Bn trains* (resupply)	241
		7610 kg
2-7 &	1 driver + 1 truck	110 kg
2-8	Basic load 29 + 4500	4529
	Bn trains	2971
		7610 kg

Serial #3 Task force B (B/278 + elements of Spt Btry)

Plane No.

3-1	1/B (26 + 2 Hq) + HMG Sq (8 + 2Hq) + 2/ATG (6) + 2/Rcl(4), 48 trps	5280 kg
	Basic load 813 + (314 + 58) + (545 + 1255) + 710 + 16)=	3711
		8991 kg
3-2	2/B (26 + 4 Hq) + HMG Sq (8) + 2/ADMG (8), 46 trps	5060 kg
	Basic load 871 + 314 + (843 + 2000)=	4028
		9088 kg
3-3	3/B (26+1 Hq) + HMG Sq (8) + Co trk, 35 trps	3850 kg
	Basic load 784 + 314 + 4500=	5598
		9448 kg

Serial #4 Task Force A (A/278 + elements of Spt Btry)

4-1 + 4-3 Same as B/278 + attachments, 3 helos.

COMBINED AIR LOADING & AIR MOVEMENT TABLE

Reference: Map Koblenz Quad

General Data

1. Marshalling area: Industriehafen, Kesselheim
2. Cruise speed: 125 knots
3. Aircraft interval: 1 & 2 in parallel columns, 140m interval between acft.
4. Routes: North from loading area to BENDORF Bridge orbit until serials formed
5. Critical points:
   IP = SE end of Industrie hafen
   RP = Deutches Eck
   (See flight rt diagram)

Serial No.	Date	Unit	Helicopters			Time			Destination
			Type	No.	Load	Load	Take Off	X-IP	
1	-	1C/278	H-6	1-1	1/C + 1 HMG/C + 3/ATG, 45 trps & 3014 kg	0250	0300	0320	LZ C
		2C/278		1-2	2/C + 2 HMG/C + 3/Rcl, 45 trps & 1940 kg				
		3C/278		1-3	3/C + 3 HMG/C + Co trk, 36 trps & 5627 kg				
		Mort Btry (-)		1-4	24 trps + Btry trk + 6161 kg (300 rds)				
		Mort Btry (-)		1-5	ditto			+8 sec	
2		Bn Hq (-)	H-6	2-1	Hq Sec + CP equip + 1 trk 16 trps + 7500 kg	0250	0300	0320	LZ D
		Bn Aid Sta		2-2	Medical Det + Aid Sta + 1 trk 5 trps + 7500 kg				
		Bn Sig Pl		2-3	Sig Pl (-) + 1 trk + equip 14 trps + 7500 kg				
		Bn Sv Pl		2-4	Sv Pl (-) + Sv equip + 1 trk 6 trps + 7500 kg				
		Bn Sig Equip		2-5	Driver + 1 trk + sig equip 1 trp + 7500 kg				
		Generator		2-6	Driver + 1 trk & generator 1 trp + 7500 kg				
		Trains		2-7	Driver + trk w/3000 kg load			+14 sec	
		Trains		2-8	Driver + trk w/3000 kg load				

Table H-6

Red 1/278 Mech Rifle Bn Air Movement Plan B

COMBINED AIR LOADING & AIR MOVEMENT TABLE

Reference: Map same

General Data

1. Marshalling area: same
2. Cruise speed: same
3. Aircraft interval: serials 2 & 3 in parallel columns, 140m interval between acft
4. Routes: same
5. Critical points: same

Serial No.	Date	Unit	Helicopters			Time			Destination
			Type	No.	Load	Load	Take Off	X-IP	
3	-	1B/278	H-6	3-1	1/B + 1 HMG/B + 2/ATG + 2/Rcl, 48 trps & 3711 kg	0305	0315	0320 +30 sec	LZ A
		2B/278		3-2	2/B + 2 HMG/B + 2/ADMG Sq, 46 trps & 4028 kg				
		3B/278		3-3	3/B + 3 HMG/B + Co. trk 35 trps + 5598 kg			+34 sec	
4		1A/278	H-6	4-1	1/A + 1 HMG/A + 1/ATG + 1/Rcl, 48 trps & 3711 kg	0305	0315	0320 +30 sec	LZ B
		2A/278		4-2	2/A + 2 HMG/A + 1/ADMG Sq, 46 trps & 4028 kg				
		3A/278		4-3	3/A + 3 HMG/A + Co trk 35 trps & 5598 kg			+34 sec	

Table H-6 (Cont.)

Red 1/278 Mech Rifle Bn Air Movement Plan B

Work Sheet Option 4: Mixed Helicopter Types, Shuttle

Initial Lift

Serial #1 Task Force C - 1st and 2nd Pls, C/278 Mech R in H-6 transports.
Plane No

1-1 1/C + HMG/C + AT Gun Sq (same as 1-1, Option 2)

1-2 2/C + HMG/C + Rcl Lchr Sq (same as 1-2, Option 2)

Serial #2 Task Force 2/A and 2B/278 Mech R, in H-7 transports.
Plane No

2-1 2B + HMG/B + ADMG + APC (same as 3-2, Option #2 plus one APC-3, w/vehicle and ADMG, SP chained to flatbed platform, troops either in the APC or prone on platform, buckled down.

2-2 2A + HMG/A + ADMG + APC (same as 4-2, Option #2 plus one APC.) Load: 46 trps (5060) + basic load (4028) + APC (13,182) = 22,270 kg.

Serial #3 Engr-Inf assault teams, in H-5 transports.
Plane No

3-1 Engr Pl Hq and Sq $^{(+)}$ (12) + R & HMG Sq 1/A (16) 28 trps (3080) + basic load (813) + Engr*(147) = 4040 kg.

3-2 2 Engr Sq$^{(-)}$ (12 trps) + R & HMG Sqs (16 trps) = 4040 kg.

1st Shuttle Lift

Serial #4 Bn Mortar Battery, in H-6 transports.
Plane No

4-1 ½ Mortar btry, basic load and trk 8801 kg.

4-2 ½ Mortar btry (same as Option 2, serial 1-5) 8801 kg.

Serial #5 Elements of Bn Hq & Sv Co in H-5 transports.
Plane No

5-1 Hq Sec plus Sig Pl$^{(-)}$ (same as 2-1, Option 1) 4493 kg.

5-2 Sig Det and equip (same as 2-3, Option 1) 3966 kg.

Serial #6 Task Force 3/B and 3A in H-7 transports.
Plane No

6-1 TF 3/B (same as 3-3, Option 2, + APC) 22,630 kg.

6-2 TF 3/A (same as 4-3, Option 2, + APC) 22,630 kg.

2nd Shuttle Lift

Serial #7. Rest of C Co plus Bn Aid Sta in H-6 transports.
Plane no

7-1 TF 3/C (same as 1-3, Option 2) 9587 kg.

7-2 Bn Medics (same as 2-2, Option 2) 8055 kg.

Serial #8 Rest of Hq & Sv Co in 1 H-5 and 1 H-7 helo.
Plane No

8-1 Sv Pl (10 trps) + basic load (290) + Sv equip (2050).

8-2 1 APC and driver + 2 trks.

2nd Shuttle lift cont.

Serial # 9 Remainder of A and B Cos in 1 H-7 and 1 H-5 helos

Plane No			
9-1	TF 1/B (less R & MG sqds) 32 trps + basic load		6588 kg.
	TF 1/A (less R, MG and Spt Btry Spds) 22 trps		2420 kg.
	1 APC-3 and driver		13,350
	Basic load		542
		Total	22,900 kg.
9-2	VATG SQ (6) + 1/ATG Sq (4) 10 trps		1100 kg.
	Basic load (545 + 1255) + (710 + 16)		2526
		Total	3626 kg.

3rd Shuttle

Serial #10 H & S APCs and trks in H-7 helos

Plane No		
10-1	1 APC and driver + 2 trks	22,350 kg.
10-2	1 APC and driver + 2 trks	22,350 kg.

Note: Remaining 31 APC and 1 truck can be airlifted into Koblenz, but if the operation was successful, they could drive across the bridge(s), or if unsuccessful, it is inappropriate to throw them away. A shuttle move stops when an outcome decision is reached.

COMBINED AIR LOADING & AIR MOVEMENT TABLE

Reference: Map Koblenz Quad

General Data

1. Marshalling area: Industriehafen, Kesselheim
2. Cruise speed: 125 knots
3. Aircraft interval: each serial in pairs, 140m interval between serials. Successive shuttles individual pairs in columns, as ready.
4. Routes: North from loading area to BENDORF Bridge orbit until serials formed
5. Critical points:
   IP = SE end of Industrie hafen
   RP = Deutches Eck
   (See flight rt diagram)

Serial No.	Date	Unit	Helicopters			Time			Destination
			Type	No.	Load	Load	Take Off	X-IP	
1	-	1C/278	H-6	1-1	1/C + 1 HMG/C + 3/ATG, 45 trps & 3014 kg basic load	0250	0320	0321	LZ C
		2C/278	H-6	1-2	2/C + 2 HMG/C + 3/Rcl, 45 trps & 1940 kg basic load	0250		+2 sec	LZ C
2	-	TF 2/A& 2/B +2 APC	H-7	2-1	2/A + 2 HMG/A + 1/ADMG Sq, 46 trps, 1 APC & 4028 kg	0250		+4 sec	LZ B
			H-7	2-2	2/B + 2 HMG/B + 2/ADMG + APC 46 trps(5060) + basic load (4028) + APC (13,182)=22,270kg	0250		+6 sec	LZ B
3	-	Engr-Inf Assault Teams	H-5	3-1	Engr Pl Hq& Sq(+), R & HMG Sq 1/A 28 trps + basic load + Engr hand-carried tools	0250		+8 sec	N. Mosel Bridge
			H-5	3-2	2 Engr Sq(-), R & HMG Sq 1/B (same equip and load)	0250		+10 sec	Balduin Bridge
Note: Load & Take-off times for succeeding shuttles dependent on turn around times.									
4	-	Mortar Btry	H-6	4-2	½ Mortar Btry + basic load +trk	?	+15		LZ C
			H-6	4-3	½ Mort Btry + basic load + trk	?	+15		LZ C
5	-	Hq & Sv	H-5	5-1	Hq Sec + Sig Pl(-) 4493 kg	?	+30		LZ D
				5-2	Rest Sig Pl + equip 3963 kg	?	+30		LZ D

Table H-8

Red 1/278 Mech R Bn Air Movement Plan D

COMBINED AIR LOADING & AIR MOVEMENT TABLE

Reference: Map SAME

General Data

1. Marshalling area: SAME
2. Cruise speed: SAME
3. Aircraft interval: SAME
4. Routes: SAME
5. Critical points: SAME

Serial No.	Date	Unit	Helicopters			Time			Destination
			Type	No.	Load	Load	Take Off	X-IP	
6	-	TF 3/A	H-7	6-1	TF 3A + APC (22,630 kg)	?	+30		LZ B
		TF 3/B	H-7	6-2	TF 3B + APC (22,650 kg)	?	+30		LZ B
7	-	C Co(-) +	H-6	7-1	TF 3C + basic load (9587 kg)	?	+15		LZ D
		Bn Aid Sta	H-6	7-2	Bn Medical team (8055 kg)	?	+15		LZ D
8	-	Sv Co(-)	H-5	8-1	Sv P1	?	+30		LZ C
			H-7	8-2	APC & driver + 2 trks	?	+30		LZ C
9	-	Rest of A & B Cos	H-7	9-1	TF 1/A(-), TF 1/B(-) + APC	?	+30		LZ B
10	-	Sv Co (Cont)	H-5	9-2	1/ATG Sq + 1/Rc1 Sq + basic load	?	+30		LZ B
			H-7	10-1	APC & driver, 2 trks	?	+30		LZ C
				10-2	APC & driver, 2 trks	?	+30		LZ C

Table H-8

Red 1/278 Mech R Bn Air Movement Plan D

APPENDIX B

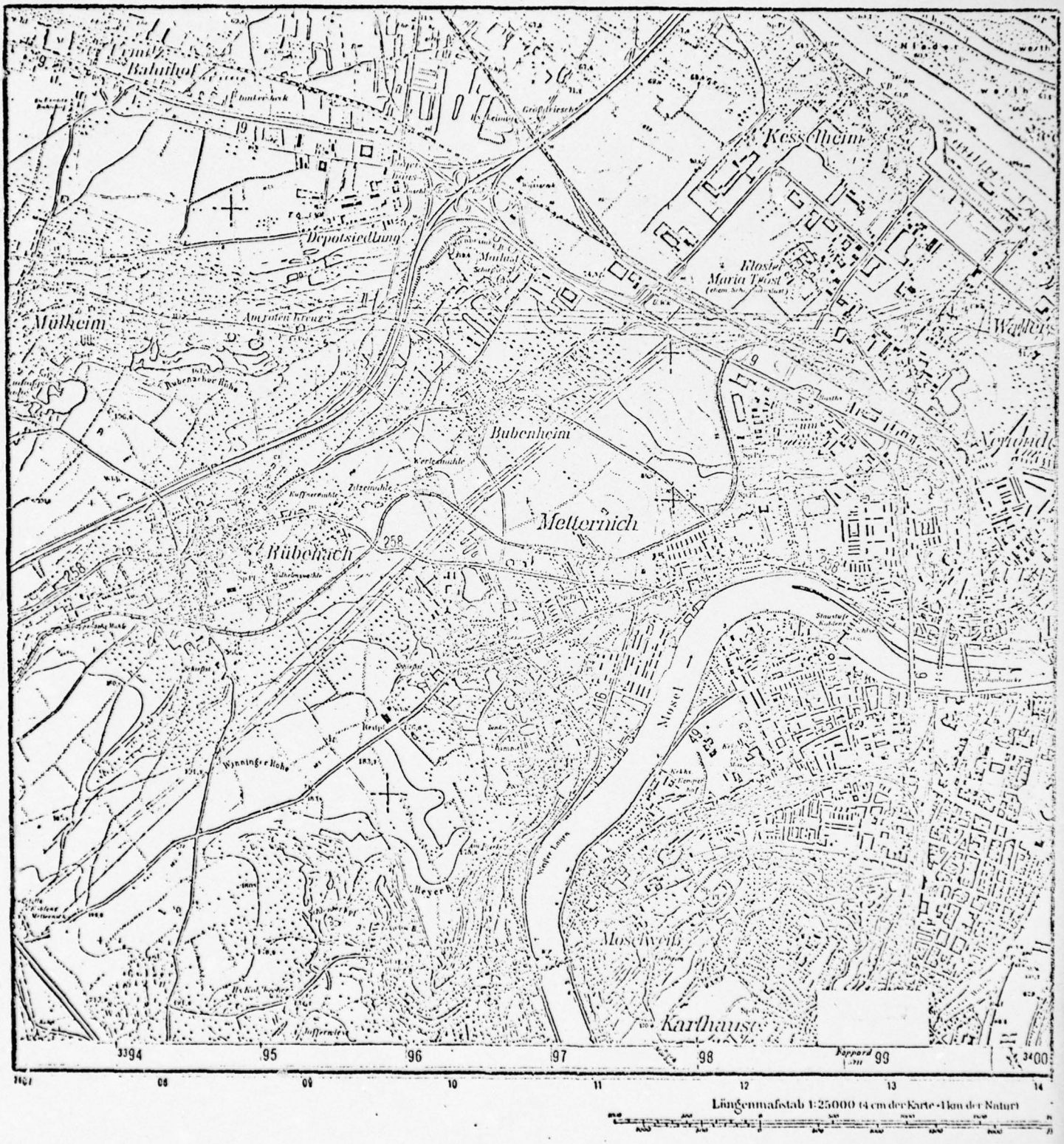
MOBAGAME SCENARIO

I. INTRODUCTION

This appendix describes a hypothetical battle between Red and Blue forces in an urban environment. Emphasis is on the depiction of events one might expect in a four-day battle within a sector of a city and its input requirements for MOBACS. The Red battalion-sized force, evolving from a larger Red force, attacks a sector of the city defended by a Blue company-sized force, which is a part of a larger Blue force deployed in and around the city to provide a complete defense.

In order to provide a realistic scenario, a portion of Koblenz (estimated population of 125,000), West Germany is used as the terrain over which the scenario of events occurs. Figure B-1 is a detailed map of Koblenz and its surrounding area. Koblenz is typical of a modern urban area, with large open areas in the outskirts, a railroad network within the city, major and secondary streets, buildings of various sizes and types of construction, various cultural centers and historical sites, and major waterways through the central part of the city. The dominant terrain features of the battle area are highlighted in Figure B-2. Significan reference points referred to in other figures include the cloverleaf, the outlying village of Bubenheim, the single-track railroad leading south and then west, and the Mosel River with the strategic bridges leading into the main section of Koblenz.

The remaining major parts of this appendix include: II - an overview of the situation; III - force lists and equipment tables; IV - tactical engagement considerations; V - a major events list; VI - an attack plan; VII - a defense plan; VIII - an overall description of the scenario; IX - an analysis of the scenario; and X - a conversion of the scenario into isolated inputs to MOBACS.



Fig; B-1 KOBLENZ and Surrounding Area

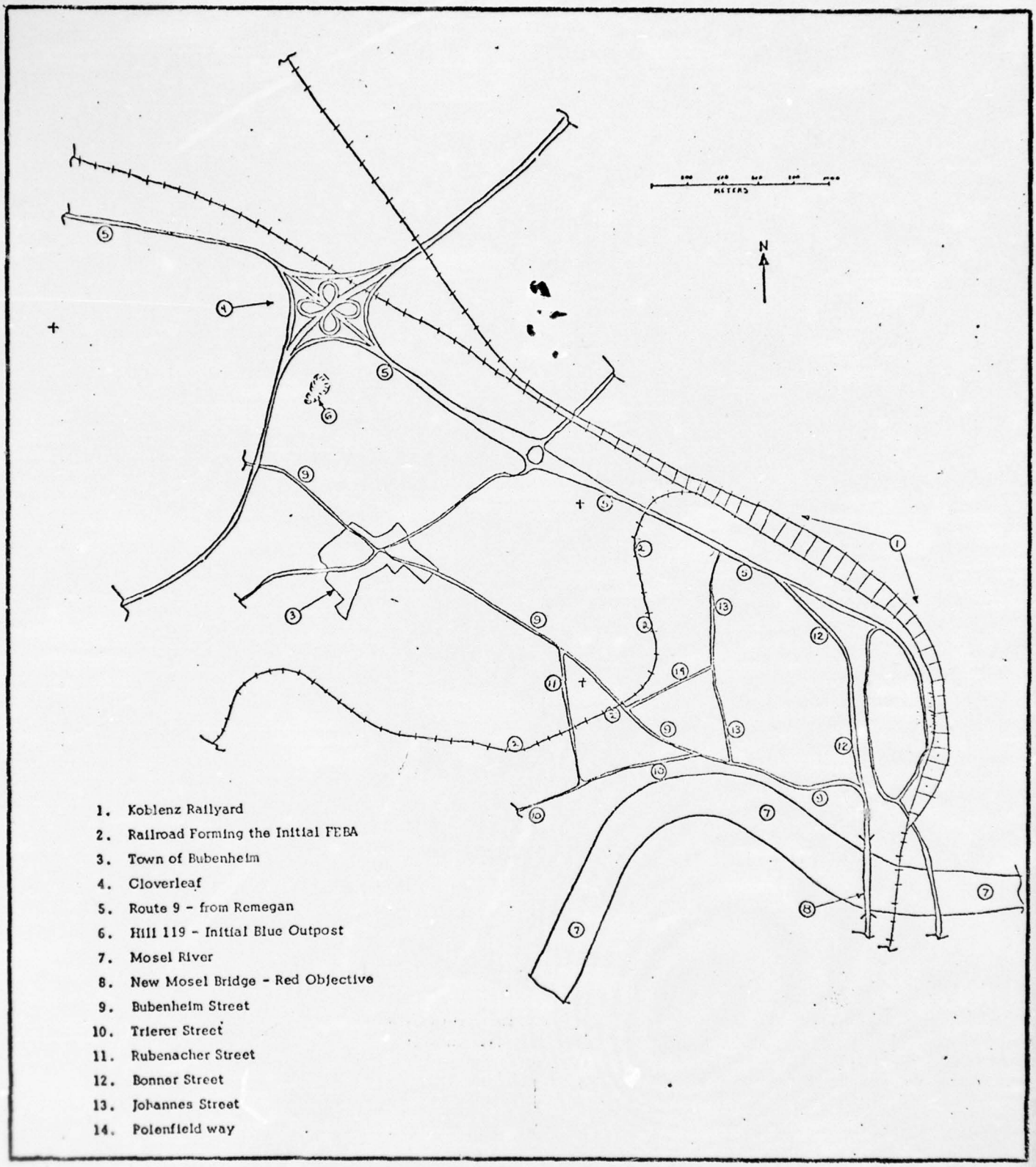


Fig. B-2; Terrain Features of Battle Area

II. THE GENERAL SITUATION

The Red Army has recently penetrated Allied positions in an area north of Koblenz, outside the major Blue force's sector around Frankfurt (see Figure B-3). Anticipating continued Red success, the Allied command calls for the Blue force in Frankfurt to move a special force to the Koblenz area to counter any Red movement back through West Germany to attack the Blue stronghold in Frankfurt.

While the Blue force deploys to Koblenz, Red establishes a bridgehead in the Remagen area and organizes for a major move to Bonn. A secondary Red force of division size is to move toward Koblenz in two major columns along major transportation arteries. The Red force of concern in this scenario will evolve from the lead echelon of the division element moving in the north along the Rhine river and over Route 9. The Red force is a mechanized infantry division and, relative to the Blue force, is heavy with armor and artillery.

The Blue force has several days in which to move to the area, develop a defensive plan, and prepare positions to repel the Red movement. The Blue force is from an infantry division and consequently reflects smaller amounts of firepower and maneuver capability than the Red attacking force.

Neither side is afforded the advantages of close air support and accompanying aerial reconnaissance.

This scenario presents a typical land combat situation except that the battle will take place in an urban area. For this reason, one can expect that the smaller Blue force with less firepower could be a reasonable deterrent if they take proper advantage of the inherent defensive factors offered by the urban environment.

An assessment of the overall purposes of this scenario indicates concentration on a battle in a small sector of Koblenz where a Red battalion-sized force is in the attack and a Blue company-sized force is in the defense.

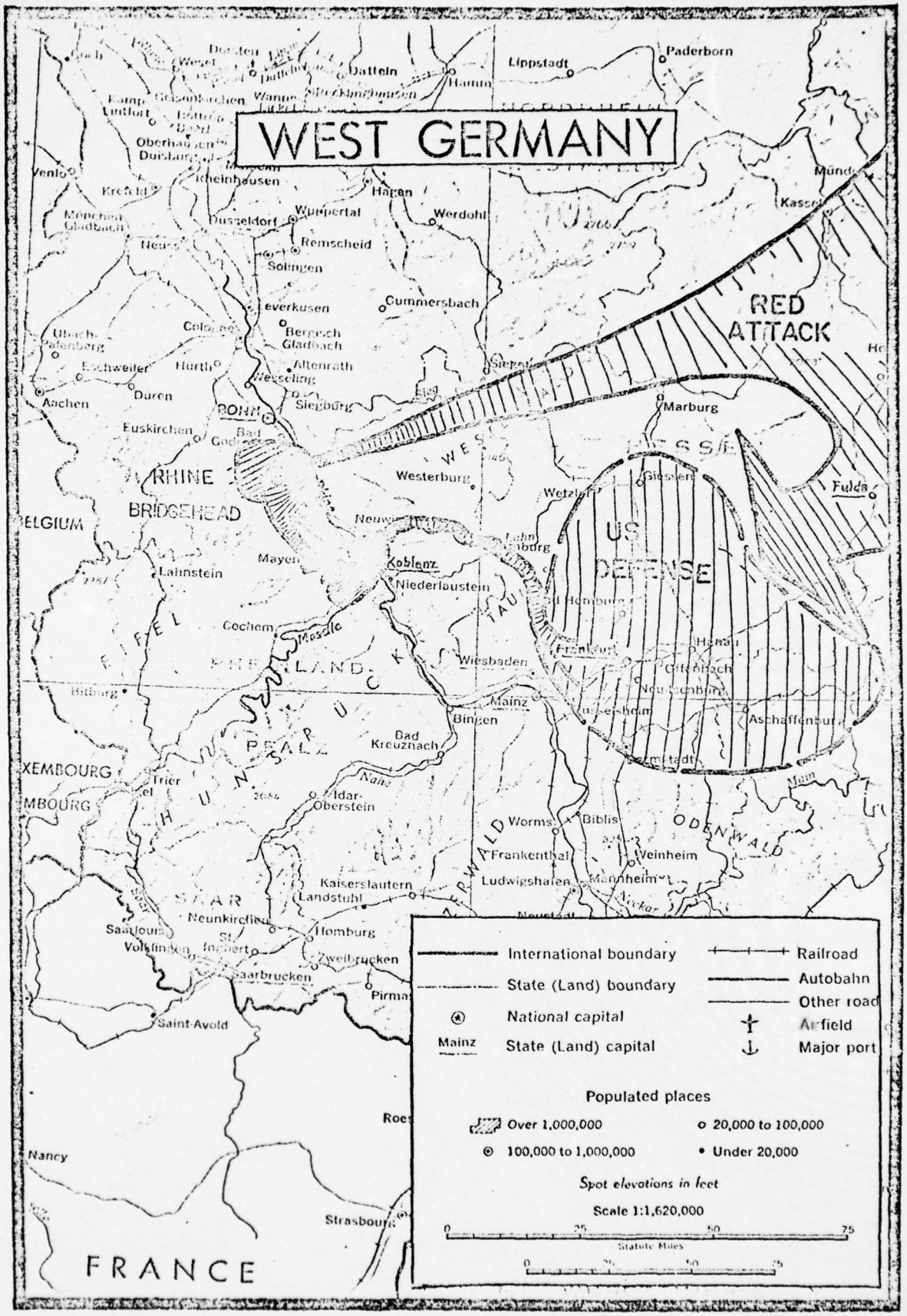


Fig. B-3; General Situation

1. Red Task Force Mission

Secure the easternmost bridge across the Mosel River in Koblenz and the route to the bridge via Bubenheim. In concert with other Red penetration moves toward the other bridges, this mission should be accomplished by Day 4. Resources are as outlined in the accompanying force structure.

2. Blue Task Force Mission

Defend sector Alpha from enemy attempts to move to or destroy the Koblenz bridges. The initial defensive line is along the single track rail line running south from the rail nexus and then west into the 2nd Battalion area. The 1st Battalion defensive forces are to operate to the north. Resources are as outlined in the accompanying force structure.

III. FORCE LISTS AND EQUIPMENT TABLES

Although there are various ways to define a company slice of an infantry division and a battalion slice of a mechanized division, a straightforward method has been used to make the first approximation. The basic Blue organization is a rifle company, one of 27 similiar organizations within a division and one of three within a battalion. The basic Red organization is a motorized rifle battalion, one of nine similiar organizations within a Red division. One-twenty-seventh of the Blue division of 16,640 is 616. One-ninth of a Red division of 11,5000 is 1,278. These are the first approximations of the MOBAGAME Red and Blue personnel strengths.

For Blue, the basic rifle company consists of 171 personnel. The Blue "slice" for this scenario might include 400 additional personnel organic to the division but not to a rifle company. Some would be organic to a battalion. Artillery forces; Cavalry forces, and Engineer forces would be used to support the MOBAGAME company. Direct support elements from the battalion in the form of mortar crews and crews for antitank weapons would also be included. This comprises the content of the Blue rifle company slice.

For Red, the basic motorized rifle battalion consists of 430 personnel. The "slice" for this scenario might include 800 other personnel organic to the division but not to the MOBAGAME Red rifle battalion. This scenario will call for a tank element contingent, mortar support, engineer support, and a heavy element of artillery support. This forms the basic Red battalion slice.

A similiar approach to determine overall equipment lists leads to rather confusing results. Therefore, several additional assumptions must be made. For Blue, as mentioned above, the rifle company is the basic force. The Blue equipment list will, thus include the TOE equipment of the rifle company. The Red equipment list will also include the TOE equipment of a motorized rifle battalion. Other nonorganic resources from supporting and higher echelon organi-

zations can be defined by the tactical mission, the additional troops inherent in a "slice", and the inferences gained from reference documentation.

The Red Force

Figure B-4 suggests the organization for the MOBAGAME Red force. The basic rifle battalion is normally within the division. The tank company is normally organic to the regimental tank battalion. The 120 mortar battery is normally organic to the regimental artillery. The howitzer battalion is normally organic to the division artillery. The Engineer Company is normally organic to the divisional engineer battalion. Consequently, the MOBAGAME Red force has tank and mortar personnel from the regiment, and artillery and engineer personnel from the division. The number and types of significant equipment with these additional personnel are postulated for this scenario and are indicated in Figure B-5.

The Blue Force

Figure B-6 suggests the organization for the Blue force. In addition to the basic rifle company, the force consists of supporting personnel normally organic to the Battalion Combat Support Company in the form of mortar personnel and antitank (TOW) crews. From the typical division, the MOBAGAME scenario will include reconnaissance, artillery, engineer, and cavalry personnel. The number and types of significant supporting equipment with these personnel are postulated for this scenario and are indicated in Figure B-7.

Analysis of Force Lists and Equipment Tables

Basically, the initial force lists and equipment tables are used to compute various ratios which the military tactician will use to gain insight into the reasonableness of the hypothetical battle. There are many ways of dealing with these ratios which often are presented to justify the reality of a particular simulation. The MOBAGAME initial force list shows a Red force superior to the Blue force in terms of personnel. Based upon a gross calculation of firepower using an index of firepower potential (IFP) values for each type of weapon, the MOBAGAME equipment lists again reveal a Red force superior to the Blue force.

There is no existing procedure to use in quantifying the ratio of maneuver capability of the two forces. One can only allude to the fact that Red is superior due to their greater numbers of tanks and other armored vehicles.

The tactics and techniques described and used in a scenario could contradict the inferences of any sterile ratios developed to determine the soundness of the hypothetical battle. For example, the Blue force list shows a large contingent of Division support personnel. Although they are included in the ratios developed, they may not contribute any damage to Red during the game. Conversely, the Red force is basically one of total combatants. The Blue force includes a Cavalry platoon used as an initial outpost and subsequently withdrawn to a reserve position. They will not contribute significantly to the battle outcome.

The following simple ratios are evident:

Personnel Ratio - Red/Blue	2.5 - 1
Firepower Potential - Red/Blue	2.5 - 1

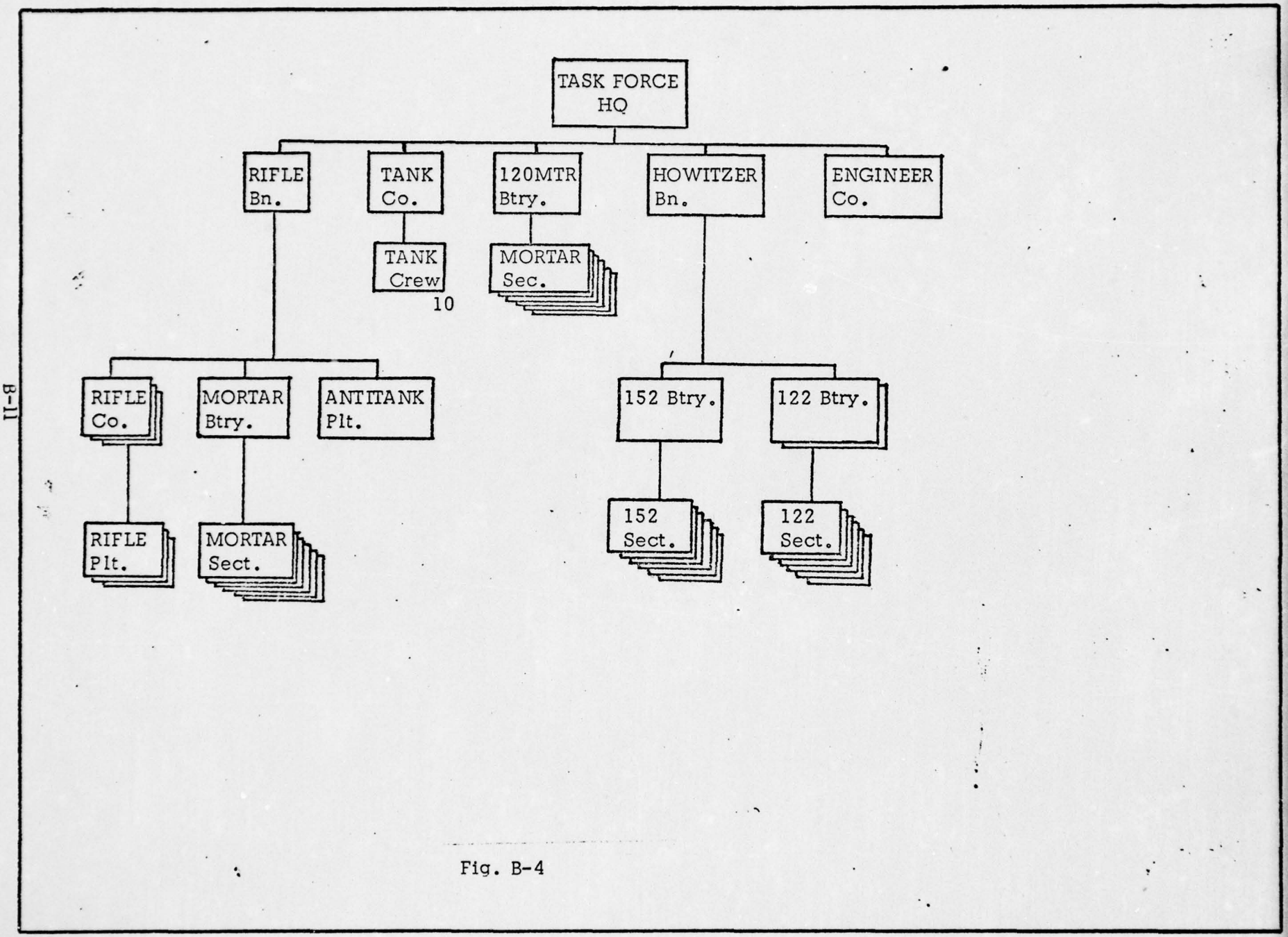

TASK FORCE HQ
RIFLE Bn.
TANK Co.
120MTR Btry.
HOWITZER Bn.
ENGINEER Co.
TANK Crew
10
MORTAR Sec.
RIFLE Co.
MORTAR Btry.
ANTITANK Plt.
152 Btry.
122 Btry.
RIFLE Plt.
MORTAR Sect.
152 Sect.
122 Sect.

Fig. B-4

Item of Equipment	IFP	RIFLE Bn.	RGMT Spt.	DIV Spt.	TF Total
Personnel	1	430	270	467	1167
RPK Machine Gun	6	27	10	12	49
120mm MORTAR	14	6	6		12
APCs	20	32	4		36
RPG-7 AT Launcher	20	9			9
SPG-9 RCLS	20	2		1	3
122 HOWITZER	30			12	12
TANK	32		10		10
152 HOWITZER	50			6	6
Firepower Potential		1536	814	1219	3569

Fig. B-5; PERSONNEL & EQUIPMENT LIST
RED TASK FORCE

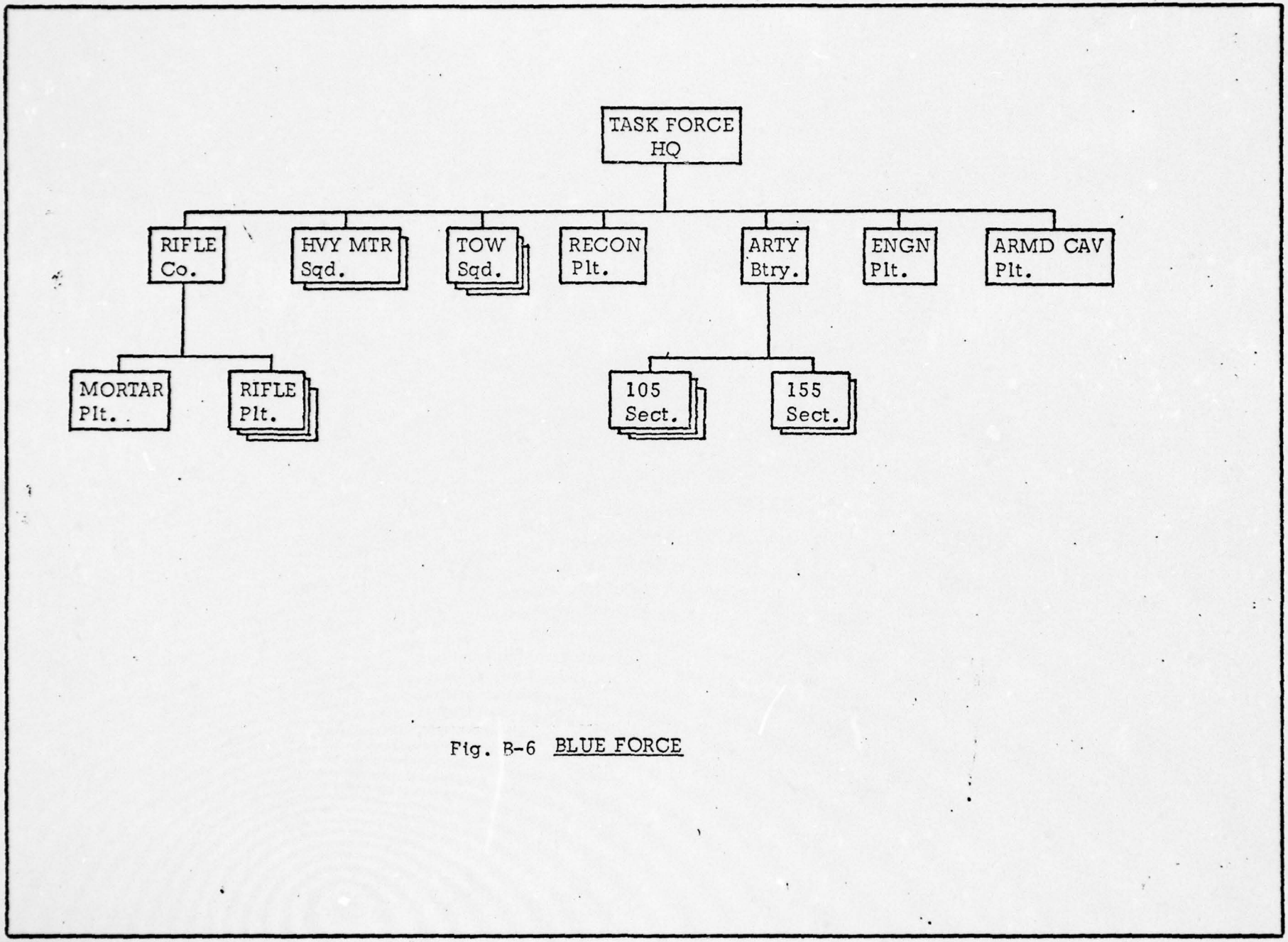


Fig. B-6 BLUE FORCE

Item of Equipment	IFP	RIFLE Co.	BN. Spt.	DIV Spt.	TF Total
Personnel	1	171	101	193	465
7.62 Machine Gun	6	6	4	11	21
81mm MORTAR	12	3			3
4.2 MORTAR	15		2		2
APCs	20			12	12
90mm RCLS	20	6		1	7
105 HOWITZER	30			4	4
155 HOWITZER	50			2	2
TOW	60		3		3
Firepower Potential		363	335	739	1437

Fig. B-7: PERSONNEL & EQUIPMENT LIST
BLUE TASK FORCE

IV. FACTORS CONSIDERED IN TACTICAL ENGAGEMENT

Several documented experiences have indicated expected outcomes from the employment of combat forces. Most of these statements refer to larger unit actions in a rural area. Although they provided insights during the development of the MOBA scenario, these experiences were considered within their proper context. Variations to such objective values are expected.

In developing the scenario, two groups of considerations were focused upon: frontages, and casualties and force ratios. In the following disucssion, we present statements, which were basically extracted from the literature, and then a comment upon them. The comment is intended to reflect how thinking would be influenced by these factors during the development of a MOBA scenario. A summary of significant planning factors is capsulized in Figure B-8.

Frontages and Depths

- Red attack frontages are 300-500 meters per rifle company.
- The Red regimental attack zone is about 4 kilometers wide, within an assigned frontage, and about 15 kilometers deep.
- The guns of an antitank platoon are located in a diamond formation about 200 meters apart.
- A Red division moving in columns may be extended over 90-120 kilometers. The minimum is 30-70 kilometers.
- In city combat, Soviet doctrine implies:
  - Frontages are small - 600 meters for battalion, 300 for company.
  - Infiltration is stressed.
  - A frontal attack will be used only if the city cannot be surrounded or is not heavily defended.

Casualties and Force Ratios

- In an attack of a fortified position--Battle losses will equal 6.3% on the first day and 3.2% on each day thereafter.

- In defense of a position--Battle losses are 1.9% on the first day and 1% on succeeding days.

COMMENT - Under this guide, we would expect the Red force tu suffer about 75 casualties on Day 1 and 34 on each succeeding day. Blue would lose about 10 people on Day 1 and 5 on each succeeding day. These absolute values seem extremely low for the intensity of the envisioned 4-day battle. They are, no doubt, reflective of larger unit actions-division or above size-and of a campaign lasting for weeks rather than the 4 days proposed in this scenario. These figures also likely reflect traditional, open area battlefields quite different from the miniature battlefield area envisioned in MOBA. A much higher battle intensity must, thus be reflected in a MOBA scenario.

- The attacker expects to enjoy at least a 2/1 force ratio prior to mounting an attack.

COMMENT - In MOBA, this typical force ratio must be greater, even as high as 10/1. Therefore, at the initial game start, the ratio should have favored Red more than the 2.5/1 ratio noted earlier. Considering the above casualty rates for attacker and defender, it is also noted that as time passes, the Red to Blue ratio can be expected to decrease. Although only a 4-day battle is envisioned here, the personnel ratio would be reduced to about 2/1 after the 4th day. Would the battle continue? Perhaps neither side would have reached a "break point," where control and/or effectiveness would be lost due to attrition. This break point is often regarded as being around 60% for an attacker and as high as 80% for a defender. By considering another logical rule, the MOBAGAME scenario was developed. It was assumed that the MOBA attacker is involved in a large-scale attack scheme and if the mission cannot be accomplished within 4 days, the overall attack plan will fail due to a time sequencing problem. The MOBAGAME scenario calls for a Red seizure of the Koblenz bridges by Day 4 in order that the larger Red force can move into Koblenz, cross the bridges, and continue the attack eastward toward Frankfurt. Without control of the bridges, the oveall Red concept would not be completed and regrouping and replanning at division level would be necessary.

FORCE	Parameter / Weapon	No. in MOBA GAME Force	Relative Fire Power Potential	Total Fire Power Potential	Maximum Effective Range (Mtrs)	Sustained Rate of Fire Rnds/Min.	Crew Members	Basic Load with Weapon	Effective Lethal Radius (Mtrs)		Standard Rate of Movement - MI/Hr-- Mtrs/Min.	Time to Emplace (Min)	Total Rnds. per day For All Type Wpns in MOBA Game	Minimum Engagement Range	COMMENT
									AP	AT					
	M 16	465	1	465	460	700	1	800	2		3-8		7000		
	7.62	21	6	126	1100	550			2		3-8		4000		
B	81mm MORT	3	12	36					60				120		
L	4.2 MORT	2	15	30					100				70		PLT FPF width = 200 mtrs.
U	APC	12	20	240			2		2		30-80		2500		
E	90 Rcl Rfl	7	20	140	400			5		2			1400		Total of 18rnds within Bn.
															BTRY FPF width = 200 mtrs.
	105 How.	4	30	120	11000	3		100	175		30-80	3	300		Total of 200 rnds in Bn.
															BTRY FPF width = 300 mtrs.
	155 How.	2	50	100	14600	1		75	360		30-80	5	100		Total of 150 rnds in Bn.
	TOW	3	60	180	3000	1	4			10	30-80		50	65	
	AKM	1167	1	1167	300	100	1	30	2		3-8		17500		
	RPK MG	49	6	294	400	600		40	2				10000		
R	120 MORT	12	14	168	5700	15			90				500		HE, Smoke rounds
E	RPG-7 ATLCH	9	20	180	500	5				5			90		Penetrates 13 inch armor
D	SPG-9 Rcl	3	20	60	1000					2			600		73mm, rocket assisted
	152 HOW	6	50	300	17000	4	8		200		30-80		300		HE, AP-T rounds
	APC	36	20	720			2		2		50-133		7000		BTR-60P, 14.5 & 7.62mm MGs, 14 pass.
	TANK	10	32	320	10000	5	3	40	150		30-80		200		Also, 7.62 MG - main gun is 115mm
	122 HOW	12	30	360	15300	7	8		150		30-80		800		HE, HEAT rounds

Fig. B-8; Basic Planning Data

V. EVENTS LIST

Day 1

RED

0800 - Column movement down Route 9

1025 - Red column diverts to assembly areas

1130 - Red force takes hastily prepared positions

1300 - Red planning for night activity

1900 - Patrols sent out to gather information

2400 - Patrols return

BLUE

1000 - Cavalry unit spots Red column on Route 9

1020 - Limited fire put onto the lead elements of the Red column

1045 - Cavalry unit withdraws

1130 - Blue command alerted of Red action

1900 - Patrols sent out to gather information

2200 - Artillery harrassment fires begin

2400 - Capture of 1 Red patrol group

Day 2

RED

0300 - Planning of Armor Assault
0600 - Preparatory fire into suspected Blue stronghold
0630 - Tanks and APCs depart assembly area
0815 - Smoke cover put up
0900 - Tanks and APCs in position in Bubenheim
0930 - Added intensity of prepatory fire and smoke cover
0945 - Armor force moves out in attack
1000 - Armor reaches minefield
1020 - Armor breaks from smoke cover
1100 - Force takes cover in railroad defilade
1230 - Evacuation of wounded
1300 - Regrouping and planning
1700 - Infiltration teams move out

BLUE

0100 - Artillery harassment fire
0230 - Artillery harassment fire
0400 - Artillery harassment fire
0530 - Artillery harassment fire
0700 - Red movement noted
0800 - Scatterable minefield laid
1000 - FPF fires
1022 - TOWs & RR engage armor
1200 - Indirect fire initiated
1300 - Planned withdrawal implemented
1400 - Indirect fire
1600 - Withdrawal complete
1700 - Street mining begins
1800 - Light patrol actions
2000 - Red team captured

Day 3

RED

0300 - 10 of 12 infiltration teams in place within buildings of Koblenz

0700 - Red indirect fires onto Blue strongholds

0730 - Tanks move out from railroad defilade

0800 - Tanks encounter plated mines

1000 - Infantry dismounts and APC withdrawn

2000 - Hand-to-hand fighting ends

BLUE

0732 - TOWs in action

0740 - One TOW destroyed

0800 - Indirect fire into city in area evacuated by Blue

1000 - Building by building fighting begins

1300 - Building fires fought by engineers

2000 - Hand-to-hand fighting ends

Day 4

RED

0100 - Infantrymen retreat to railroad

0400 - Mounted APCs withdraw to Bubenheim

0800 - Harassment artillery fire begins

1200 - Replanning at regimental level

BLUE

0700 - Evacuation of prisoners

0800 - Evacuation of casualties

0900 - Planning at battalion level

1000 - Deactivation of mines begins

1200 - Return to forward defensive positions

1300 - Resupply and reorganization

VI. RED PLAN FOR ATTACK (See Figure B-9)

On Day 1, the Regimental force is to move down Route 9 toward Koblenz. Since the town is being defended, the march will halt and move into various assembly areas about 8 kilometers NW of Koblenz prior to continuing onto the City on Day 2. Little or no combat action would be expected on Day 1 since most Red activity would be outside the range of the emplaced Blue defensive positions. In order to take advantage of an attack from the march, the forward elements of the Red force will consist of an artillery element and the tanks and APCs needed for the initial tactical move on the City in Day 2.

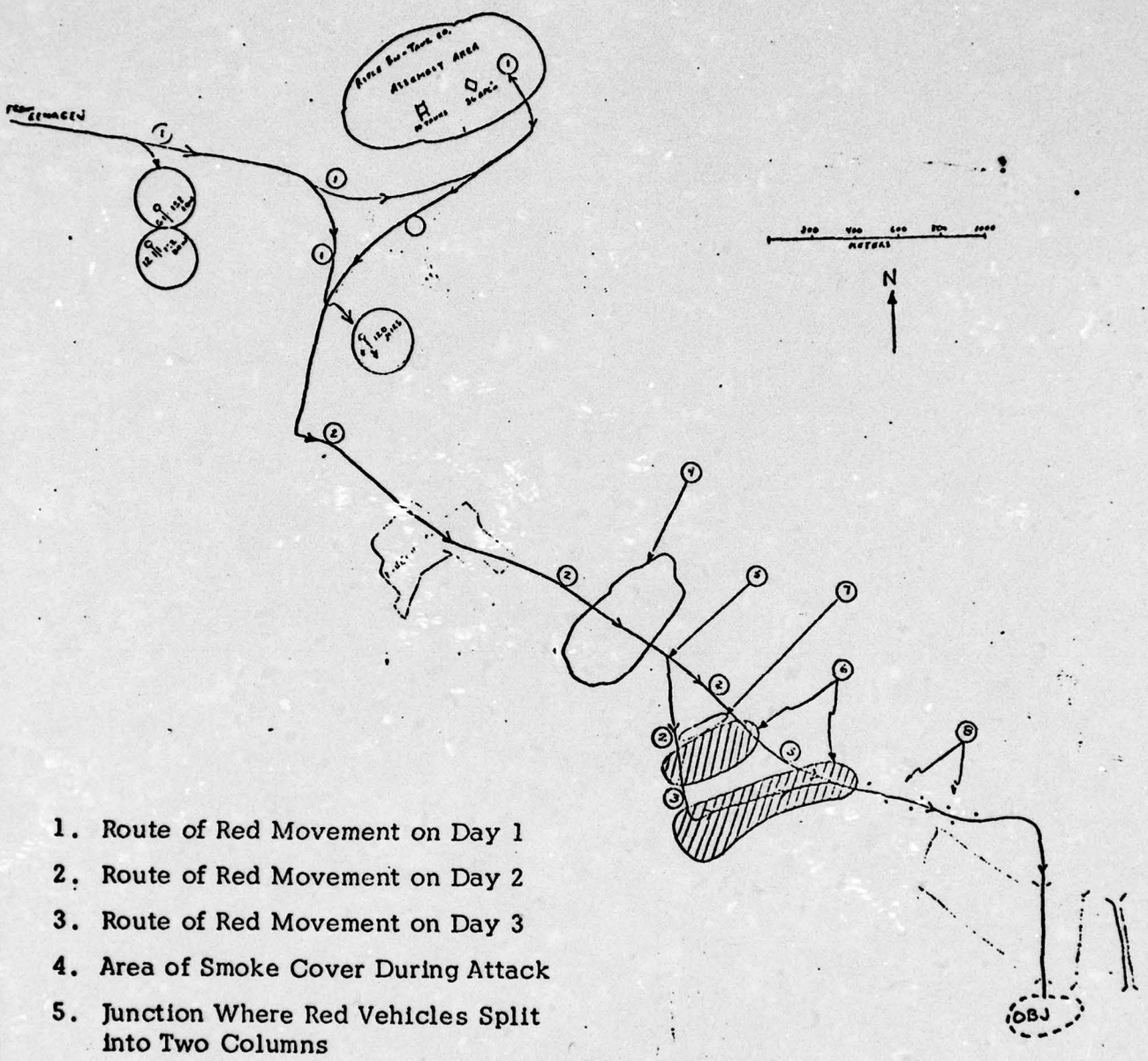
Early in the morning of Day 2, the artillery will commence prepatory fire while the tanks and APCs form up and move from their assembly areas to the area of Bubenheim. Red artillery fire will be lifted upon command of the maneuver element commander when he judges his force to be in a position whereby they are detrimentally affected by his own friendly incoming artillery rounds.

The Red maneuvering force expects little resistance until they begin their move down the road from Bubenheim to Koblenz. The open area on both sides of the roadway can be used for a frontal attack if necessary, although the terrain dictates that the natural passages into Koblenz in this sector is by way of two separate crossings under the single-track railroad. As the tank and APC forces move toward Koblenz, some casualties will be acceptable to Red in favor of a continued armor penetration toward Koblenz where the assault takes two basic routes to the bridge area.

Although the most natural approach to the bridges is the direct route along the river, the southern group of tanks and APCs will move somewhat as a diversionary force with the possibility of uncovering a weaker frontal area of the defenders. Each group will consist of 3 sets of 1 tank and 3 APCs. Their

ultimate mission is to move and to secure the bridges in order that the following elements of the regiment will have free access to the routes through Koblenz.

The movement discussed here is key to this scenario, although the overall Red tactical plan of the regiment calls for a second battalion-sized force to move directly down Route 9, into Koblenz and to the bridge area. The other divisional element is moving toward Koblenz far to the south. The divisional plan calls for a regrouping of the division on the east bank of the Rhine on Day 5. At this time, the Red force will have cleared approaches through Koblenz and additional forces can be readily assembled for the push toward the Blue force in Frankfurt.



1. Route of Red Movement on Day 1
2. Route of Red Movement on Day 2
3. Route of Red Movement on Day 3
4. Area of Smoke Cover During Attack
5. Junction Where Red Vehicles Split into Two Columns
6. Areas of Mortar/Arty Prep Fires
7. Defilade Area for Tank/APC Cover
8. Observation Positions of Infiltration Teams

Fig. B-9; Red Plan of Attack

VII. BLUE PLAN FOR DEFENSE (See Figure B-10)

By Day 1, the Blue force will have established its initial defensive positions in accordance with the overall defensive plan for protection of Koblenz. Since intelligence sources have indicated a possible Red force movement, the entire perimeter of Koblenz must initially be protected. These initial defensive positions are established in order to gain early warning of the Red force penetration.

The Blue force of concern in this scenario has only a small frontage specified in the total Blue defensive area. Other Blue forces will be in position to defend agains the secondary thrust from the northern element of the Red division.

Basic to the Blue force are resources consisting of the Rifle Company and supporting weapons deployed in defensive strongpoints along and behind the railroad tracks leading southward from Koblenz. Positions are such that firepower is concentrated around three TOWs providing protection in the open area through which Red will pass. Each TOW position is augmented with a basic combatant force of a rifle platoon with individual weapons, 7.62 machine guns, and 90mm recoilless rifles. The company is supported by the firepower of an equivalent set of three 81mm mortars, two 4.2 mortars, four 105 howitzers, and two 155 howitzers. Ammunition supplies for the supporting howitzers include rounds of scatterable mines as well as the normal HE, smoke, and AT rounds.

The relative positions of all weapons employed in the sector being defended would put the TOWs, machine guns, and recoilless rifles at 800-1000 meters range; the mortars at approximately 2000-3000 meters; and the artillery at approximately 6000 to 8000 meters.

The defensive planning has allowed time for development of communication systems and for the use of indirect fire weapons to fire registration rounds into several locations. Within the specified defensive sector, registration

points have been defined as the road junctions over which the Red force is expected to move from Bubenheim to Koblenz. No registration points have been determined within the City.

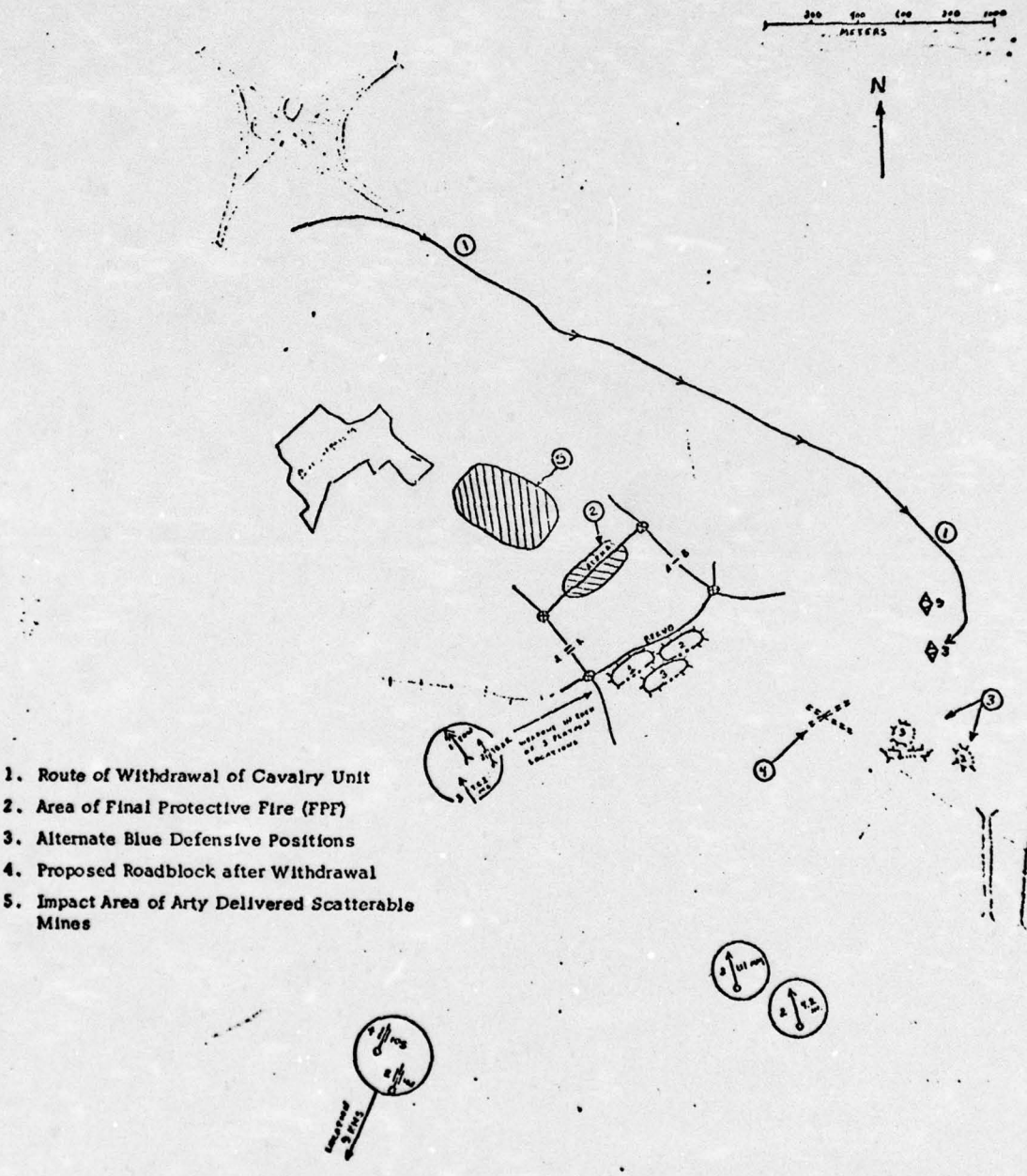


Fig. B-10; Blue Plan for Defense

VIII. CONTROL DESCRIPTION OF THE BATTLE

Little damage will result from the Day 1 activity. Although the Blue force has placed a Cavalry unit in an outpost near the cloverleaf for early detection of Red activity, they will immediately move back into the defensive cover of the battalion after they sight the point of the Red column and fire several rounds of ammunition causing the point to disperse and take cover. Without continued fire from Blue forces, Red continues to move to their pre-planned assembly areas by nightfall of Day 1.

Blue is now alerted to Red activity in the area. Since all defensive positions have been prepared and it is determined that the Red activity does not warrant any repositioning, the Day 1 activity will close with little more than minor patrol activities by both the Red and Blue forces.

Early on Day 2, the Red artillery commences fire into the Blue force locations. This fire, in the area of well-fortified defensive positions, has little casualty-producing effect, but the major intent is to suppress the Blue forces while the Red maneuver element of tanks and APCs depart the assembly area and move toward Bubenheim. This movement eventually brings the Red armor within about 1200 meters of the Blue force. The Blue force is able to detect movement but through the combination of terrain features, suppression fire, and range, they are unable to produce any damage from the emplaced TOWs or from indirect fire.

The Red approach route is obvious at this time and Blue covers the route across the open area with scatterable mines from several rounds of artillery shells. The indirect fire weapons are alerted to the pending actions in this area and prepare to fire armor-piercing rounds into the open area when forward observers notice the Red movement across the area and into cover behind the railroad tracks.

At 0930 on Day 2, the Red artillery puts a smoke screen in the open area to cover the Red armor advance into Koblenz. Consequently, the Red force movement over the open area is hindered only by the off-route scatterable mines and the indirect fire until Red forces come within about 600 meters of the Blue TOWs and recoilless rifles. It can be assumed that Red forces would lose 1 of their 9 tanks and 3 of their 27 APCs to the minefield and the indirect artillery fire until the armor moves from the smoke cover to the cover behind the railroad. During this time, which should be approximately 4 minutes, each of the TOWs would get off 2 rounds at rather short range. The recoilless rifles would engage the more vulnerable APCs and by the time Red forces reach cover, 2 additional tank kills and 5 APC kills are registered. This leaves the Red maneuver force with 6 tanks and 19 APCs intact and halted close to the Blue defense position.

During the afternoon of Day 2, the battle again returns to one of indirect fire exchange. Red forces are in a position to observe their fire coming in on the defensive positions of Blue. They will attempt to eliminate the TOW and recoilless rifles if artillery is able to destroy the protective cover afforded by the structures surrounding the emplaced positions. Blue will attempt to damage that armor force which is covered behind the railroad tracks. This will take extremely accurate indirect fire along with the expenditure of AP ammunition.

During the nighttime hours, considerable activity takes place although no significant combat engagements are held. Blue forces realize that Red has only tow passages available to cross the tracks and move to the bridges. They will put indirect fire onto these railroad overpasses in order that the rubble will provide at least a temporary barrier to the tanks and APCs when Red forces move during Day 3. Further, engineer troops will be called upon to quickly emplace anti-armor mines in the approaches that the Red forces would use after they pass over the railroad and move into Koblenz. The TOWs and RR are repositioned in order to take advantage of the time Red will consume in moving through the rubble on their approach into town.

During the night, Red personnel will dismount from the APCs and form twelve 6-man patrol groups who are to move silently on foot across the tracks and gain information of the Blue defensive positions during the night. They are then to move to positions along the routes to the bridges and take cover in evacuated buildings. As the armor force move on Day 3, they would then be in positions to observe and take under fire all Blue positions which become exposed while attacking the Red armor. The Red communication system becomes critical for guiding the armor through any known emplaced Blue mines. The firepower within each patrol group will be RPG-7 (9 total) or an SPG-9 (3 total). Additionally, each group has two RPK machine guns, individual weapons, and hand grenades.

On Day 3, the Red armor, with blades attached, begins to remove the rubble of the blow railroad overpasses. During this time, several rounds of Blue indirect fire (artillery and mortars) are used in a harassing attempt with no real damage. After the passages are cleared, the 7 tanks and 19 APCs split with 3 tanks and 8 APCs in the north and 4 tanks and 11 APCs in the south. As the lead tanks move into line-of-sight for the Blue TOWs, they are engaged and destroyed. This reveals the locations of the Blue TOWs to the Red infiltration parties, which then call indirect fire and eliminate one TOW. The solid defensive positions provide adequate protection for the other two TOWs although the suppressive efforts will certainly reduce their rate of fire when additional tanks and APCs charge through the gaps. During Day 3, both forces incur heavy losses. The armored force is essentially stopped and the Blue heavy weapons (TOWs and recoilless rifles) are essentially silenced.

During the night of Day 3 and into Day 4, the battle becomes one of infantry using individual weapons in and around the buildings of Northern Koblenz. In essence, Blue has paid a price but did halt the armor force short of the bridges. Little damage has been made on either side's indirect fire weapons, which are available yet to fire upon targets of opportunity or as called for by the ground forces fighting in the built-up areas.

In this sector, Red will essentially be eliminated as the ground forces will move back across the tracks, mount into the undamaged APCs (still in cover), and return to safety for regrouping at their assembly area near the cloverleaf. In this battle, the defense has succeeded.

IX. ANALYSIS OF SCENARIO

Neither side is a real winner. Blue is judged as successful in that they withstood the armor assault and did not allow Red to seize the bridges within the time period required in the higher echelon plan. Blue expended significant resources. Anti-armor weapons are damaged and anti-armor ammunition has been expended.

The outcome of any continuation of the battle in this sector would depend upon the timeliness of planning and resupply as well as the outcomes of battles in other sectors. If resource depletions in other sectors are not comparable with those envisioned here - if Red is held but not destroyed in the north, for example - a shift of the remaining armor to counterattack in this sector could be quite successful for Red. Blue anti-armor resources are depleted. The battle obviously changes to one of intelligence-gathering and behind-the-lines mobility and resupply.

During the battle depicted, several critical points are noticed. Would Red mount an armor attack in an area where the front will converge on two railroad underpasses at a point near their enemy? Would their intelligence have been adequate for them to even know that this would be the case? Would the protection afforded to the Blue TOW position really have withstood the Red indirect fire for the period of time noted, allowing them to be as effective against the Red tanks? The Red movement from Buben heim was through their own smoke cover and through a Blue minefield of artillery-delivered scatterable mines. Possibly, the limited vision afforded tank drivers through the smoke cover would enhance the effectiveness of a scatterable minefield even more than was depicted. However, if the tanks stayed on the hard surface road, would they even have encountered the mines? Do we know of the patterns of scatterable mines falling from artillery shells into an area of earth and roadways? Possibly those landing on the hard surface would break up and be ineffective. Then, by staying to the

roads, the armor is safely through a smoke cover. How effective would the TOW system be in the heat of weapons exchange? With target exposure times being small (no more than 4 minutes), the opportunity for Blue to be successful against the enemy's significant capability is short. If Red could reach the railroad cover with just a few additional tanks, the next day's battle could be significantly different.

There are innumerable isolated happenings in a day's worth of combat which could produce quite different results. The picture developed here seems to be one of many typical possibilities. This depiction allows for a base from which additional work can evolve and provide insights into MOBA.

X. INPUTS FOR MOBACS

In this section, the basic force disposition and game start inputs needed in a run of MOBACS are highlighted. In addition, some of the major events during the game are indicated via the type orders to be developed for separate units in the conduct of these events. With this set of inputs, a run through MOBACS is possible.

Game Map and Initial Force Disposition. Figure B-11 reflects the basic plan for the exercise run and the initial disposition of the Red and Blue Forces. Each force initially will be located in three separate areas on the map. The precise locations of each are logical positions on the terrain of Koblenz. A point at the lower left-hand corner of this map was arbitrarily established as the game board origin and its reference to the Koblenz Map (Figure B-1) is obvious. All initial disposition areas, secondary positions, and final positions represented on Figure B-11 are drawn to scale and indicate data needed as input to this automated run of MOBACS. The reader is urged to refer to Figure B-11 as further descriptions of this exercise run are provided.

Force Structure (Red and Blue). Tables B-1 and B-2 reflect the indented force structure tables required to assure valid inputs on the force structure card. Each organizational entity is called out along with its function during the exercise. All battle units are designated at the fifth level of the organizational hierarchy. Others are command units or maneuver control units in this exercise. The MOBACS names were arbitrarily defined and they meet the requirements specified in MOBACS as simply being a player-selected 4-character designation. All Red MOBACS names begin with an R while Blue names begin with a B. The number of each type unit deployed in this exercise is indicated in the right-hand column of the tables.

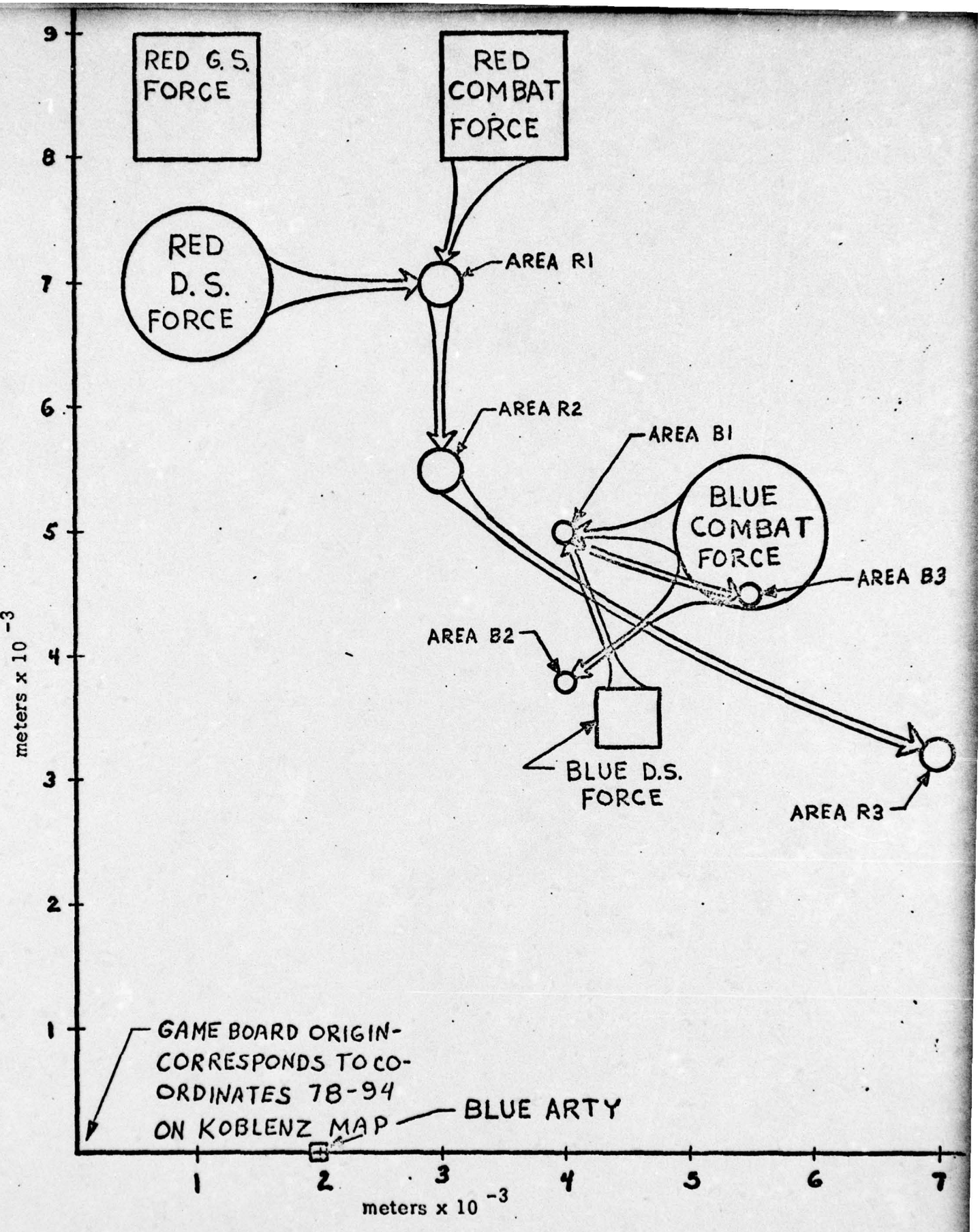


Fig. B-11; Exercise Game Board

Table B-1; RED FORCE STRUCTURE

NAME	FUNCTION	LEVEL	MOBACS NAME	NUMBER
Red Task Force	CU	1	RDTF	1
Combat Force	CU	2	RBCF	1
Rifle Battalion	CU	3	RRFB	1
Transport Unit	MCU	4	RTMC	3
APC	BU	5	RAPC	3
Rifle Company	MCU	4	RRFC	3
Rifle Platoon	BU	5	RRFP	3
Mortar Battery	MCU	4	RMTB	1
Mortar Section	BU	5	RMTS	6
Anti-Tank HQ	MCU	4	RHAT	1
Anti-Tank Platoon	BU	5	RATP	1
Direct Support Force	CU	2	RDSF	1
Mortar Battery	CU	3	RSMT	1
Mortar MCU	MCU	4	RMMC	1
Mortar Section	BU	5	RMTS	6
Tank Company	CU	3	RTCO	1
Tank MCU	MCU	4	RTAC	1
Tank	BU	5	RTNK	1
Tank Platoon	MCU	4	RTAP	3
Tank	BU	5	RTNK	3
General Support Force	CU	2	RGSF	1
Artillery	CU	3	RART	1
152 Battery	MCU	4	R5MC	1
152 Section	BU	5	R152	6
122 Battery	MCU	4	R2MC	1
122 Section	BU	5	R122	6
Division Support	CU	3	RDIS	1
Engineer MCU	MCU	4	RECU	1
Engineer Platoon	BU	5	RENG	1

Table B-2; BLUE FORCE STRUCTURE

NAME	FUNCTION	LEVEL	MOBACS NAME	NUMBER
Blue Task Force	CU	1	BLTF	1
Combat Force	CU	2	BBCT	1
Rifle Company	CU	3	BRFC	1
Motor Platoon	MCU	4	BMTP	1
Mortar Squad	BU	5	BMTS	3
Transport Unit	MCU	4	BTMC	3
APC	BU	5	BAPC	4
Rifle Platoon	MCU	4	BRFP	3
Rifle Squad	BU	5	BRFS	4
Direct Support Force	CU	2	BBSF	1
Combat Support Company	CU	3	BCSC	1
Mortar MCU	MCU	4	BMMC	2
Mortar Section (Heavy)	BU	5	BHMS	1
Anti-Armor MCU	MCU	4	BAAM	3
TOW	BU	5	BTOW	1
General Support Force	CU	2	BGSF	1
Artillery	CU	3	BART	1
105 MCU	MCU	4	BOMC	3
105 Section	BU	5	B105	1
155 MCU	MCU	4	BSMC	2
155 Section	BU	5	B155	1
Division Support	CU	3	BDIV	1
Engineer MCU	MCU	4	BEMC	1
Engineer Platoon	BU	5	BENP	1
Calvary MCU	MCU	4	BCMC	1
Armored Cavalry Platoon	BU	5	BACP	1

Organization for Combat. Figures B-12 and B-13 illustrate the organizational charts which could be assumed to reveal the two forces in this exercise. Each reveals a 5-level hierarchy with each force being defined overall as a Task Force with levels of headquarters superior to the specified battle units. The major resources of each type of battle unit are noted at the bottom of the figures. The numbers on the lines leading from the battle units (circles) to their immediate superior command unit (or maneuver contro unit) indicate the number of separate battle units organic to the command unit. For example, there are to be 3 Rifle Platoon battle units in each Rifle Company within the Red Task Force. This corresponds to the organization implied in the Force Structure Tables noted above.

This organization reveals that Red has a total of 79 units (200 allowed in MOBACS) with 8 different type battle units (15 allowed in MOBACS). Blue has a total of 66 units and 9 different type battle units (the same limitations apply to the Blue force as to the Red force in MOBACS). Using these figures, the user can quickly determine the MOBACS generated name for each unit in the game. For example, RDTF will be R1; RBCF will be R11; RRFB will be R111; RTMC is three units and are R1111, R1112, and R1113. Battle units under R1111 would further be defined as R11111, R11112, and R11113. MOBACS listings will refer to units by these code names rather than the 4-character player-defined names noted on the Force Structure tables.

It should be noted that a battle unit is not necessarily unique to a single command unit. The Red 120 mortar section is the battle unit type for the Mortar battery located within the Rifle Battalion as well as the Mortar battery in direct support of the Battalion.

Another peculiarity can be noticed in the Blue structure which is required for MOBACS processing. A TOW battle unit is defined as a squad and as consisting of one TOW plus the individual weapons of the squad members. Each battle unit is headquartered by a maneuver control unit. In this way, the player

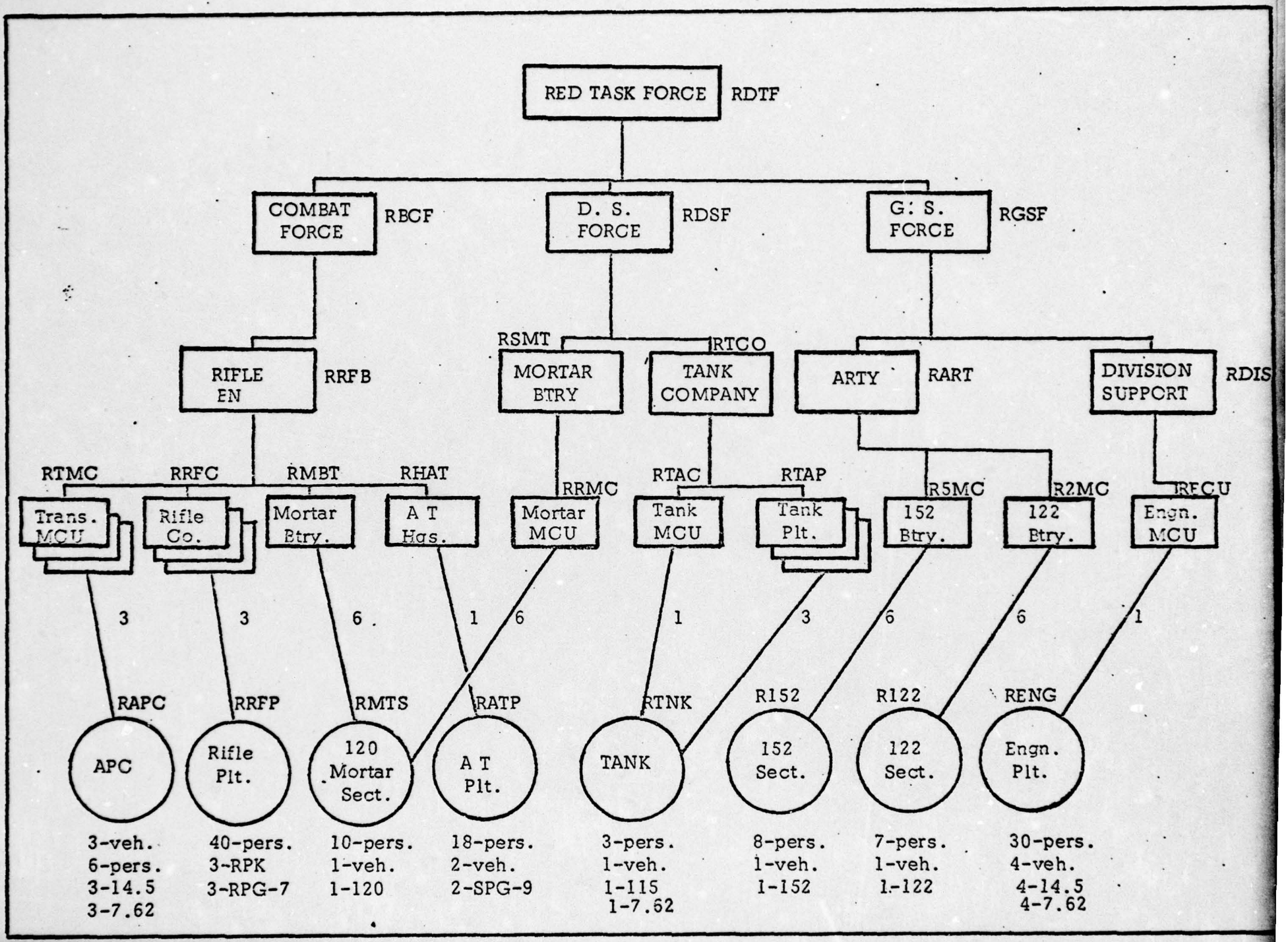
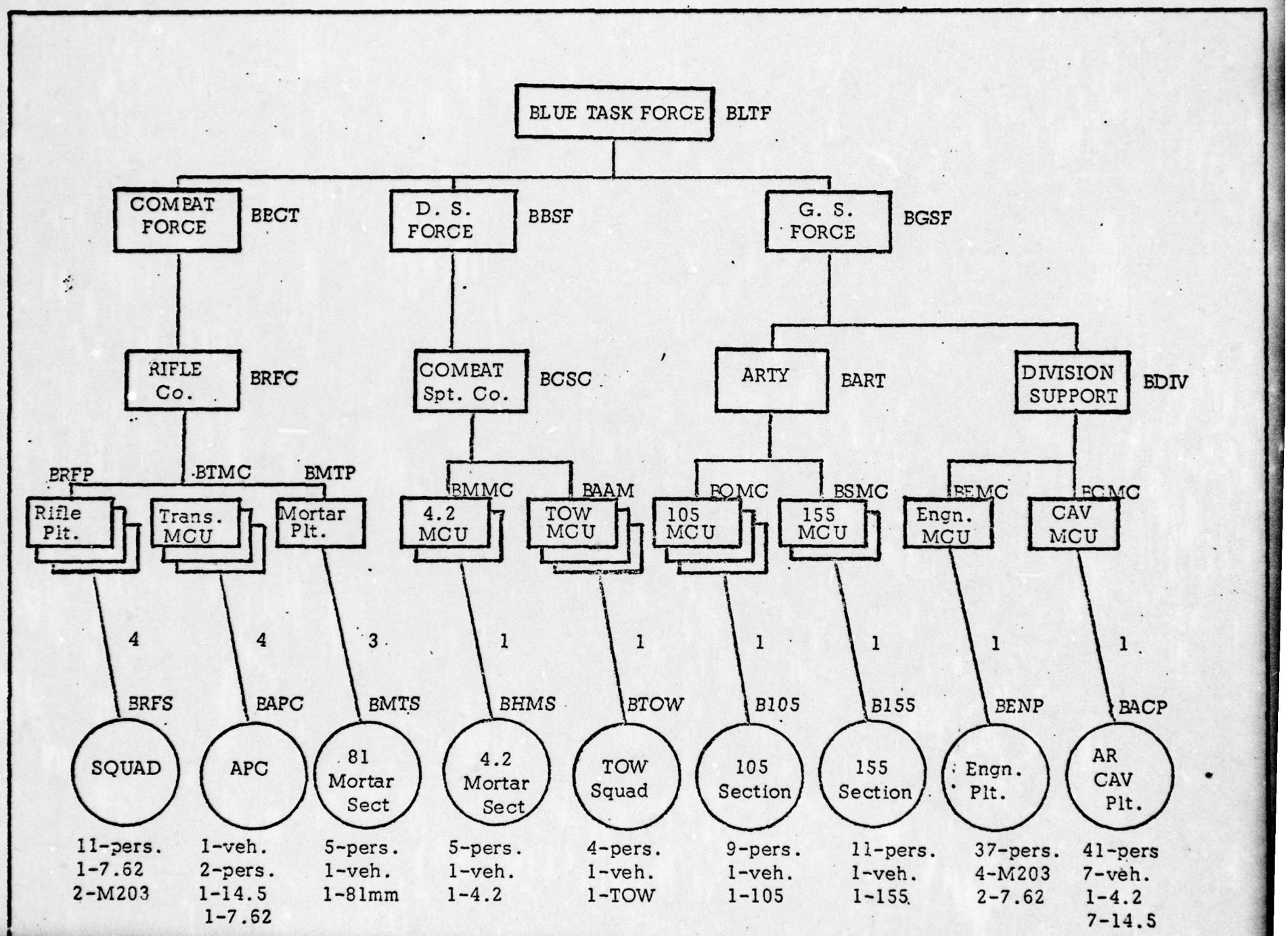


Fig. B-12; Red MOBACS Organization


BLUE TASK FORCE BLTF
COMBAT FORCE BBCT
D. S. FORCE BBSF
G. S. FORCE BGSF
RIFLE Co. BRFC
COMBAT Spt. Co. BCSC
ARTY BART
DIVISION SUPPORT BDIV
BRFP
BTMC
BMTP
BMMC
BAAM
BOMC
BSMC
BEMC
BCMC
Rifle Plt.
Trans. MCU
Mortar Plt.
4.2 MCU
TOW MCU
105 MCU
155 MCU
Engn. MCU
CAV MCU
4
4
3
1
1
1
1
1
1
BRFS
BAPC
BMTS
BHMS
BTOW
B105
B155
BENP
BACP
SQUAD
APC
81 Mortar Sect
4.2 Mortar Sect
TOW Squad
105 Section
155 Section
Engn. Plt.
AR CAV Plt.
11-pers. 1-7.62 2-M203
1-veh. 2-pers. 1-14.5 1-7.62
5-pers. 1-veh. 1-81mm
5-pers. 1-veh. 1-4.2
4-pers. 1-veh. 1-TOW
9-pers. 1-veh. 1-105
11-pers. 1-veh. 1-155
37-pers. 4-M203 2-7.62
41-pers 7-veh. 1-4.2 7-14.5

is permitted to maneuver the TOW squads separately. In the case of the rifle squads, maneuver is still by the command unit (or the maneuver control unit), but the 4 squads of one platoon will be maneuvered as a single unit. This indicates that control is always by way of a command unit or MCU and not directly by the battle unit itself.

The Battle Units. For this exercise run of MOBACS, the separate battle units are further described in tables B-3 and B-4. In MOBACS, each battle unit can be provided with up to 4 different types of weapons. For this run, we have considered that weapon type 1 is the individual weapons of the personnel of that battle unit. Consequently, a Blue mortar section has a weapon type 1 as 5 individual weapons. Therefore, weapon type 1 has the firepower equivalent of 5 (not 1) individual rifles. A unit such as the 155 section, will logically contain various types of artillery rounds. In this case, each type of round is defined as a separate weapon. For the 155 section, for example, Weapon Type 1 is 11 individual rifles; Weapon Type 2 is a high explosive projectile; Weapon Type 3 is an armor-piercing projectile; and, Weapon Type 4 is a smoke round. These are specifically called out on the Battle Unit Data Card.

The Orders. For this brief exercise, we will use several of the units which have been initially deployed as a part of the combat force, the direct support force, or the general support forces noted on Figure B-11. Specifically, we will order actions for: the Red Rifle Company (R1114), the Red APC Unit (R1111), the Red Tank Platoon (R1222), the Blue Rifle Platoon (B1111), the Blue TOW section (B1213), the Blue Mortar Platoon (B1117), and the Blue 105 Section (B1311). All initially deployed units will have a first order to hold fire. The above named units will maneuver and fire at each other automatically and as directed by the following set of orders.

The Red Rifle Company - At game start, they will hold fire and mount up into the APCs of the APC unit. They will provide firepower support to the APC unit until they are dismounted from the APCs in Area R2. Here they delay 10 minutes

Table B-3: RED BATTLE UNITS
By means of extrapolating data from the Field Manual FM30-40, the MOBACS exercise run uses Red battle units as described below. In some cases, their weapons are referred to as their U.S. counterpart name.
Rifle Platoon - This battle unit in MOBACS is comprised of 40 people, three RPK machine guns and three RPG-7 Anti-Tank launchers. This unit does not have organic vehicle transportation. Mortar Section - This unit consists of 10 people, a 120mm mortar and organic vehicle transport. Anti-Tank Platoon - This unit consists of 18 people and their two SPG-9 anti-armor weapons. Tank Crew - For MOBACS, each tank is considered a battle unit. Each tank used 3 people and has a 115mm main gun and a 7.62mm machine gun. 152 Section - Each section, of which there are six in the battery, consists of 8 people and their 152 howitzer. 122 Section - Each section, of which there are six in the battery, consists of 7 people and their 122 howitzer. Engineer Platoon - For the MOBACS exercise run, this unit consists of 30 people and 5 APC type vehicles which are armed with a 14.5mm and a 7.62mm machine gun.

Table B-4; BLUE BATTLE UNITS

By means of extrapolating data from U.S. mechanized infantry TOE documents, the MOBACS exercise run uses battle units with resources as follows.

Rifle Squad - This unit consists of 11 people, a 7.62mm machine gun and two M203 grenade launchers. They are foot soldiers without organic vehicle mobility.

Mortar Section - This unit is typically a part of the Rifle Company's Mortar Platoon. Each section consists of 5 people and an 81mm mortar. They have organic vehicle transport.

Transport Unit - This unit is created for MOBACS as being a basic armored personnel carrier (APC) with a crew of 2 people. The carrier has a 14.5 caliber machine gun as well as a 7.62mm machine gun mounted. It is basically compatable to a Rifle Squad for which the APC provides vehicle transport.

Heavy Mortar Squad - This unit in MOBACS evolves from within the Battalion's Combat Support Company. It has organic vehicle transport for its 5 people and its single 4.2 inch mortar.

TOW Squad - This unit evolves from within the Battalion Combat Support Company. It has organic vehicle transport for its single TOW launcher and the crew of 4.

105 Section - This unit consists of a typical 105 howitzer gun crew with 9 people, their 105, and organic vehicular transport.

155 Section - This unit consists of a typical 155 howitzer gun crew with 11 people, the 155, and organic vehicular transport.

Engineer Platoon - This unit in MOBACS, evolves from the Division Engineer force. They have 37 people with weapons consisting of four M203 grenade launchers and two 7.62mm machine guns.

Armored Cavalry Platoon - This unit is created for MOBACS and consists of 41 people. Their firepower is based upon a 7.62mm machine gun, a 4.2 inch mortar, ten M203 grenade launchers and the machine guns (7.62mm and 14.5 mm) mounted upon their 7 armored carriers (APCs).

during artillery preparatory fire into an area over which they will move. If the delay period is passed and if they still have a significant portion of their people remaining, they are to begin a move toward Area R3. If, in any frame, their resources are attrited below a specified level, control calls a halt to the game.

The Red APC Unit - At game start, they will hold fire. As the Rifle Company mounts into the APCs, they begin to move to Area R1. During this move, they return to a normal firing status. After they arrive in Area R1, they determine if the tank company has also arrived. If not, the IF order will allow them to delay until the tanks arrive and then both armor units will continue to move to Area R2 with the APCs carrying the rifle company. When the APCs arrive in Area R2, and when it is assured the tanks have also arrived, the infantry will dismount. Then the APC unit will disperse within Area R2 and use their weapons to cover the battlefield.

The Red Tank Platoon - At game start, they will hold their fire and move to Area R1 where they will return to normal fire. When they are assured that the APC unit is in the area, the move will continue onward to Area R2. When both units are in Area R2, it is assumed that they will delay during a 10 minute artillery fire. If, after the artillery fire, their value remains high, they begin moving toward Area R3. If their value is not high, then, or at anytime during the move, control stops the game.

The Red Artillery Battery - At game start, they will hold fire. When the Red maneuver force reaches Area R2, it is assumed that the artillery will be called to fire a protective cover. When the force gets to Area R2, the artillery unit returns to normal fire and fires a mission for 10 minutes into the Area over which the maneuver elements expect to pass. After the completion of this mission, they hold their fire.

The Blue Rifle Platoon - At game start, they hold fire and move to Area B1. After arriving, they disperse into sturdy structures within the Area and return

to a normal firing mode. If, during the play, the value of the unit gets low, control stops the game. If, at any time, it appears as if the Red force is attriting them to a degree greater than desirable, the platoon withdraws to their base area and into the security of the larger Blue force. If, at any time during the move, their resources are depleted, control stops the game.

The Blue TOW Section - At game start, they hold their fire and move to Area B1 with the rifle company. Upon arrival, they will dig in and take cover among the buildings and return to a normal fire mode. If, during the game, the rifle company takes a degree of casualties, the TOW section will withdraw along with the rifle platoon to the security of the base area.

The Blue Mortar Section - At game start, they hold fire. It is determined that they must locate separately from the Rifle platoon and therefore, the mortars move to Area B2 and set up position. They return to a normal fire mode. When Red is "observed" in Area R2, the mortars fire a mission.

The Blue 105 Section - At game start, they hold fire, although the immediately return to a normal fire mode. Like the mortars, when Red activity is "observed" in Area R2, they fire a mission into that area.

The play will stop when any of the following conditions are met.

- The Red rifle company is significantly attrited.
- The Red tank company is significantly attrited.
- The Red rifle company reached Area R3.
- The Red tank company reaches Area R3.
- The Blue rifle platoon is significantly attrited.

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13. ABSTRACT

This volume is the Final Technical Report: Gaming Models for Military Operations in Built-Up Areas (MOBA). It describes the results of research performed under Contract DAAH01-C-74-0710. These results include the design, development, and exercise of a gaming structure comprising two distinct levels of gaming. Both levels of gaming employ a player directed simulation called Military Operations in Built-Up Areas Combat Simulation (MOBACS). The results reported in this volume are supported by four additional volumes of user documentation.

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